



AUTOPILOT

P I LOTSTAR *D*

Typ AP02-S01

1 Description

2 Operation

3 Care, Maintenance and Shipboard Repair

4 Installation, Putting into Operation

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SAFETY REGULATION



► **Note**

The desired rate of turn depends

- on the initial turning behaviour of the ship
- and on the adjusted parameters.

When the ship starts turning, the rate of turn may be increased up to approx. 50%!

► **Note**

Set heading differing by more than $\pm 180^\circ$ from the ship's current actual heading are not executed over the shorter heading by the PILOTSTAR D.

The set heading change is carried out to corresponding with default set heading $> 180^\circ$.

► **Note**

Operating mode of **HEADING CONTROL**

If the magnetic compass values and gyro compass values are different, switching-over to the compass reference results in a preset heading adaptation.

Possible heading differences between set heading and heading remain in existence.

Operating mode of **TRACK CONTROL**

In this operation mode the actual heading may differ from the heading indication, depending on the track error.

SAFETY REGULATION



Note

Autopilot operation at high speeds.

(HSC High Speed Craft, according to IMO guidelines from 30kn to 70kn)

On pages HSC-1, HSC-2 and HSC-3 the behaviour rules for the following situations are documented:

- 1. Sensor failures**
- 2. Autopilot errors**
- 3 Hazard when accelerating or changing heading and in heavy seas**



Please note

According to new maritime regulations the meaning of "SET COURSE" has to be changed into "SET HEADING".

This is performed allover the manual except display indications.

1. Sensor failures

No.	Action	Effect	Operator Note	Reaction time
1	Failure of the log	If NMEA speed is disturbed LOG FAIL is announced optically and acoustically.	Switch over the log to manual speed input.	The reaction time - switching over to manual input - is not critical as long as the speed is to be maintained.
	Plus Log Low Speed	For speeds below 3 knots, alarm message <u>Low Speed</u> is announced optically and acoustically on the control unit.	"RELAYS ALARM" output active (see section 4.7).	
2	Error in the heading reference	A heading reference failure is sensed and announced optically and acoustically on the control unit as <u>Gyro Fail</u> . The last valid actual heading is frozen and is used from then on as the heading reference. The set heading should be the same as the actual heading in order to prevent any rudder reaction. It is no longer possible to set a heading on the control unit.	a) Reduce the speed to values < 20 knots. Switch over to the magnetic compass or to the second gyrocompass, if one is available. Optimize the control parameters during magnetic compass operation if stable regulation is not available.	If it is necessary to make a maneuver, it is necessary to switch over immediately to manual control.
			b) Switch over to manual control and use a second heading reference that is not subject to errors.	
			"RELAYS ALARM" output active (see section 4.7).	

2. Autopilot errors

No.	Action	Effects	Operator Note	Reaction time
1	System error / Power down	The autopilot can no longer be used in the case of a system error. The effects cannot be described accurately in each case. The aim is to maintain the current rudder position when dealing with the error. A system error is announced optically and acoustically on the signal unit (relays B21, power fail).	Switch over to manual control. Reduce the speed so as to be able to better control any possible rudder equalization operations.	The reaction time - switching over to manual control - is necessary to switch over at once.
2	Error in the operator unit	A operator unit error in the form of an electronics failure has no effect on the current controller behavior. The operator notices that the operator unit can no longer be used because nothing is shown on the display or else sees the <i>No Connection</i> message. After approx. 45 seconds indication on relays B21, auto fail.	Switch over to manual control, since it is not possible to make any more heading settings and there is no further control over the autopilot (warnings, alarms, parameter settings).	The reaction time - switching over to manual control - is not critical
3	Error in the control unit	The autopilot can no longer be used. Immediate identification on relays B21, auto fail.	Switch over to manual control. Reduce the speed so as to be able to better control any possible rudder equalization operations.	The reaction time - switching over to manual control - is necessary to switch over at once.

3. Hazard when accelerating or changing heading and in heavy seas

No.	Action	Effects	Operator Note	Reaction time
1	Acceleration of the ship	Automatic adaptation of the controller to the speed is especially important during acceleration. A missing log (e.g. errors) can cause controller instability and unpleasantly larger rudder angles.	If it is not possible to ensure a log function, the ship must be accelerated slowly to the desired speed and the speed input made manually. Rudder limiting should be set to the maximum permissible value.	Switch over immediately to manual control in the event of controller instability.

No.	Action	Effect	Operator Note	Reaction time
2	Change of heading	Changes of heading are to be done such that any unacceptably high centrifugal acceleration is avoided ($< 0.05g$). This reduces the risk of accidents to the passengers and any shifting of loads. Computed relationship: $a = d \cdot v$ a = acceleration (centrifugal acceleration) d = turning speed when changing heading v = travelling speed You can see that the turning speed and the travelling speed have a proportional effect on the acceleration. The turning speed must be selected in relation to a desired maximum speed such that the acceleration rates described above are not exceeded. Turning speed limiting can be set at the autopilot.	Determine the maximum permissible turning speeds for various travelling speeds (depending on the passengers and the load). Determine the maximum amount of rudder limiting.	It is necessary to reduce the travelling speed at once if there is excessive centrifugal acceleration.
3	Seas	a) The speed of the ship must be matched to the current sea conditions. This determination must be made in connection with the ship safety regulations. (Wave height and maximum permissible speed) b) The effects of heavy seas can also cause undesirably high rudder amplitudes with the autopilot.	Increase the yawing setting until a compromise is reached between rudder action and heading accuracy for a travelling speed that is still permissible.	In the case of impressibly large rudder movements it is necessary to reduce the travelling speed for safety reasons. Then check the yawing setting.

User information:

In case a sensor failure is not longer active – the user gets an acoustical signal and has to quit the message to be aware that the system is in ready condition again.



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List of Abbreviations:**A**

- APA - NMEA telegram header "APA"
- APB - NMEA telegram header "APB"

C

- CNT.RUD - counter rudder
- HEADINGMON - heading monitoring (Magnet, Gyro)
- CRS.TYPE - heading type
- CPU - central processor unit
- CONFIG. on - configuration mode on
- CONFIG. off - configuration mode off

D

- DC - DC supply voltage

E

- EEPROM - electrically erasable, programmable read-only memory
- EXT.CRS - external set heading

F

- FAIL - failure
- FU - follow-up

G

- GPS - global position system
- GYRO FAIL - gyro compass failure

I

- I/O-PCB - input / output printed-circuit board
- IP - Interelement protection

L

- LCD - liquid crystal display
- LOG TYPE - speed sensor type

M

- MAG TYPE - magnetic sensor type
- MAGNET FAIL - magnetic failure

N

- NAV TYPE - navigation data type
- NAVDATA FAIL - navigation data failure
- NFU - non-follow-up
- NMEA - National Marine Electronics Association

O

- OFF TRK - off-track,
- OFF CRS - off-heading
- OFF HEADING - Off Heading

P

- PCB - printed-circuit board
- PANEL FAIL - panel failure
- PARAM - parameter

R

- RUD.LIMIT - rudder limit
- ROT °/MIN - set rate of turn in °/min
- RUD.SCALE - rudder scale
- RUD.SLACK - rudder slack
- RUD.LEAD - rudder lead
- RUD.SPEED - rudder speed
- RUD.FAIL - rudder failure

S

- STBD - starboard
- SERV CODE - service code
- SER.OUT - serial output type
- SYNCHRON. - step compass synchronization
- STEERING FAIL - steering failure



T

- TRIM YAW - 2nd parameter for yawing (TRIM MODE)
- TRIM RUD - 2nd parameter for rudder (TRIM MODE)
- TRIM CNT - 2nd parameter for counter rudder (TRIM MODE)
- TRACK LIM - track limit

W

- WP - waypoint
- WOP-circle - wheel over point circle

X

- XTE TRIM - Cross Track Error Trim

Attention

Change of “Preselected heading”

A change of preselected heading can be done by using the rotary knob or the Port/STBD arrow keys.

In both modes the ship follows the respective heading adjustment within a range of 0 to 359,9°. It means, there will be an all-around circle.

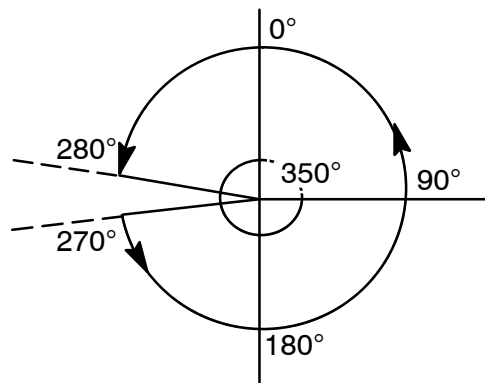
For example: Actual heading is 270°.

New heading will be 280°.

Direction of rotation should be Port.

The new heading will be 280° after a around circle of 350° with a direction of rotation to port.

Vessel follows the user input direction on the operator panel.



Direction of rotation of the preselected heading

1 Description

1.1 General

The PILOTSTAR D is a comfortable digital autopilot system ensuring safe and simple handling.

The PILOTSTAR D offers the following steering modes:

- Heading control acc. to a manually adjusted set heading preselection
- Heading control with rudder trim function (work mode)
- Track control in conjunction with a navigation receiver
- Heading control with serial set heading preselection (REMOTE operation)
- Manual control (DODGE function)
- Change-over to manual and tiller operation

The regular system includes (see Fig. 1-5):

- the main operator unit
- the connection unit
- the rudder angle feedback unit

1.1.1 The Operator Unit

The operator unit is equipped with several lettered membrane keys, a rotary knob for the set heading preselection and with a LCD display.

The operator unit can be subdivided into two logic fields of application, i.e. the monitoring field and the operating field.

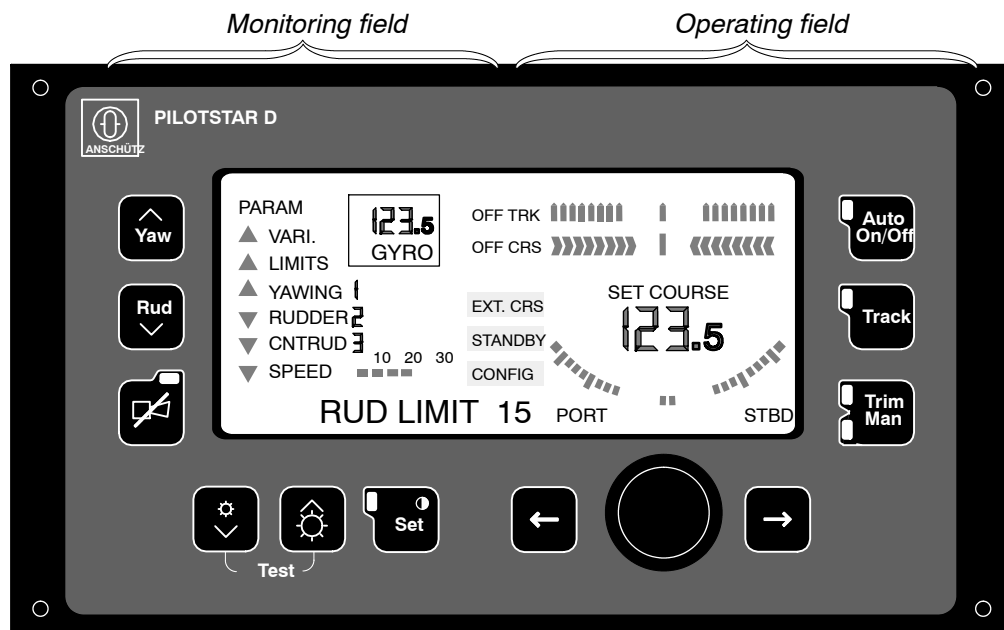


Fig. 1-1: Operator Unit PILOTSTAR D

- **The monitoring field** (see also Annex -1) *indicates*

- the current heading (**actual heading**) as a digital display. Below the heading display, the selected heading sensor type will be faded in.

GYRO for gyro compass

MAG for magnetic compass or fluxgate compass.



- the **essential, operational adjustments** which may quickly be called up and varied according to the situation.

The arrow symbols indicate the key by means of which the wanted parameter is to be called up.

- the **text line** by means of which all interactive inputs and other device messages can continuously be read off:

Indication of a parameter and of its value

Disturbance messages in plain text

Information on service support

Keys in the monitoring field



} open the parameter list in the LCD display



acknowledges the internal alarm signalling



Test

Universal keys for:

dimming the LCD display,
varying of parameter values,
lamp test



acknowledges the adjusted synchronization value
and is used for fading out the operational parameters
within the text line



- The **operating field** (see also Annex -1)

Within the operating field, five status indicators indicate the instantaneous, active mode of the autopilot.

Status indicator: **OFF TRACK** stands for **Track Control active**.

Status indicator: **OFF COURSE** stands for Heading **Control active**.

Status indicator: **EXTENSION COURSE** stands for **Heading Control active**.
The autopilot here receives its set heading preselections via an external navigation system.
The PILOTSTAR D track controller now cannot be activated;
change-over to the operating mode TRACK is not possible.
Manual set heading preselection via the PORT/STBD keys or via the rotary knob is not possible now.

Status indicator: **STANDBY**
The operator unit has now an indicating function only, such as:
– the indication of the current heading and
 set heading information.

The operating mode STANDBY is adjusted automatically with changing over the steering mode selector (position HAND) or with connecting a second steering station (2nd operator unit, tiller).

Status indicator: **flashing**
With opening the parameter list for the PILOTSTAR configuration (CONFIG. on), the status indicator starts flashing (see Chapter 2.4).

Keys in the operating field



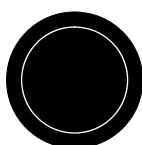
changes over to the operating mode of heading control (LED alight);



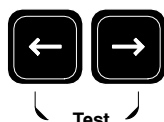
changes over to the operating mode of track control (LED alight)



changes over to the operating mode of manual control (LED alight);
changes over to the operating mode of heading control with extended
trim function - WORK mode - (LED alight)

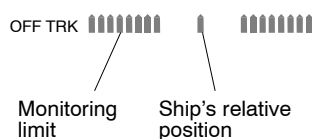


Rotary knob for set heading preselection (resolution 0.5°)



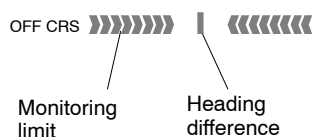
Alternative set heading preselection via PORT/STARBOARD keys (resolution 1°)

Bar Graph Indicators



- **OFF TRACK** in the operating mode TRACK (track control)

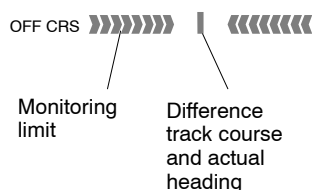
The centric segment represents the ship's position with regard to the planned track. If the ship is running symmetrically within the monitoring limits, it follows the planned track without considerable track error. If the segment e.g. drifts to the right, the ship is running on the right of the track, and vice versa. Passing over from one segment to another corresponds to a deviation of 0.01nm.



- **OFF HEADING** in the operating mode AUTO (heading control) and TRACK (track control)

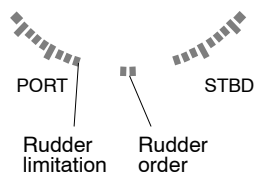
Operating mode AUTO

The centric segment represents the heading difference between the set heading and actual heading. One segment corresponds to a heading deviation of 2°. The monitoring limits show the permissible limit range for the heading difference.



Operating mode TRACK

The centric segment represents the difference between planned track course and actual heading during track control (caused by drift or weather conditions). Passing over from one segment to another corresponds to a difference 2° more or less.



- **Rudder angle indicator**

The centric segment describes the rudder order. Passing over from one segment to another corresponds to a rudder movement of 2°. The rudder limitation describes the permissible limit range for the rudder movement.

1.1.2

The Connection Unit

The connection unit is made up of various PCBs.

Among them are:

- CPU PCB
- I/O PCB
- Junction PCB
- Backplane

On the basis of the universal interface structure, the connection unit permits the connection of various sensors and system-extending components, such as:

- up to three tillers (NFU, FU)
- up to two additional operator units as secondary steering stations
- two separate rudder angle indicators
- further multifunction indicators
- interfaces for a navigation receiver or for an external navigation system.

1.1.3

The Rudder Angle Feedback Unit

The rudder angle feedback unit receives the mechanical rudder movement and converts it into an analog voltage.

The voltage level is transmitted to the connection unit and used there for comparing the rudder set/actual value.

(See also respective manual for the Feedback Unit).

1.2 General Information on the Autopilot Configuration

Exact heading control or track control depends on the various basic adjustments of the autopilot (for detailed information see Chapter 2.3, Chapter 2.4 and Chapter 4.13).

A difference is made of between the ship-specific and the operational adjustment of parameters.

1.2.1 Ship-specific Adjustments

Ship-specific adjustments are performed – after installing the autopilot – via the operator unit. The controller-specific and the ship-specific parameter values will be entered into a separate parameter list. These entries are to be performed once. As to system engineering, these values are written into an EEPROM and, therefore, stored.

Ship-specific parameters are e.g.:

- the ship's length
- the maximum rudder angle.

1.2.2 Operational Adjustments

Numbered among the operational adjustments are the controller-specific, variable parameter values.

Variable parameters are required in order to adapt the optimum controller characteristic to different situations, such as:

- other weather conditions
- speed changes if no log sensor is available, etc.

These variable parameters are included in a parameter list as well. A part of this list is continuously indicated on the LCD display of the operator unit.

By actuating the "**Trim**" key, a second set of parameters can be called up, indicated on the LCD display and varied, if required.

This 2nd set of parameters is often used for special manoeuvres or operations (WORK MODE) (see Chapter 2.2.9).

1.3

Principle of Operation

The autopilot is used for the automatic heading or track control. A microprocessor-controlled control circuit – taking into account the ship-specific and operation-conditioned adjustment – takes over the ship's steering control (see Fig. 1-2).

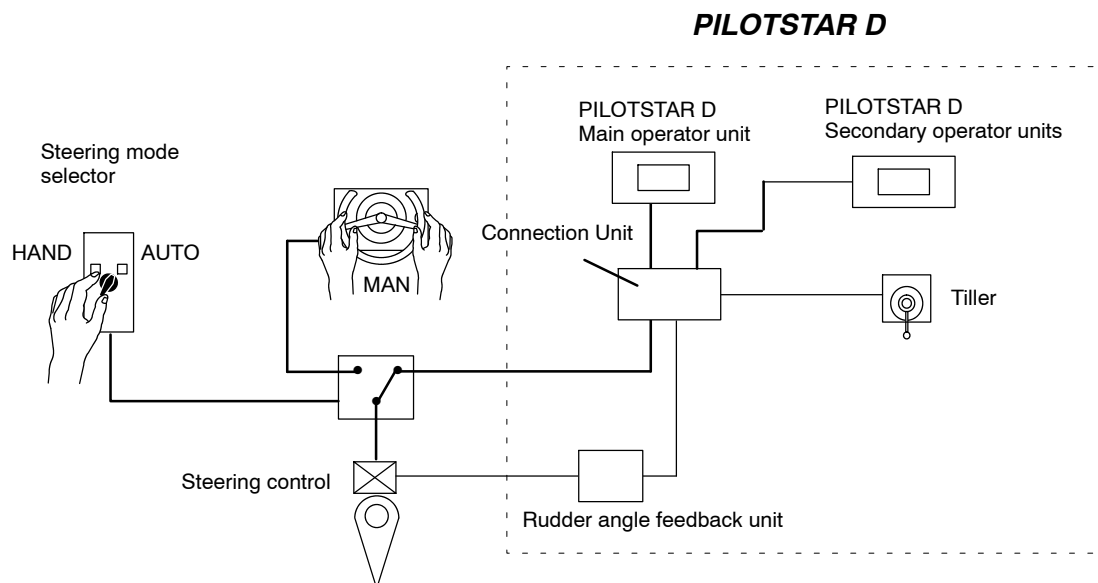
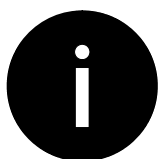


Fig. 1-2: Schematic Diagram: Manual Steering Control / Automatic Steering Control

NOTE

The automatic heading or track control is a great ease for the helmsman, but it does not relieve him of his legal obligatory supervision, i.e.:

- continuous observation of sea waters! -

If set heading data is above 180° the ship will follow the direction entered. The heading will **NOT** change over the shorter route.

1.3.1 Heading Control with Set-heading Preselection

The set heading value is to be varied by re-adjusting the rotary knob or the arrow keys.

The rudder angle indicator will be deflected correspondingly and indicates the rudder order.

The ship turns with the desired rate-of-turn pre-setting (ROT °/ MIN) and with taking into account the current speed (if LOG SENSOR available, otherwise manual preselection, SPEED) into the new set heading (see Fig. 1-3).

The OFF CRS bar graph indicator shows the decreasing heading difference of between the heading and the set heading.

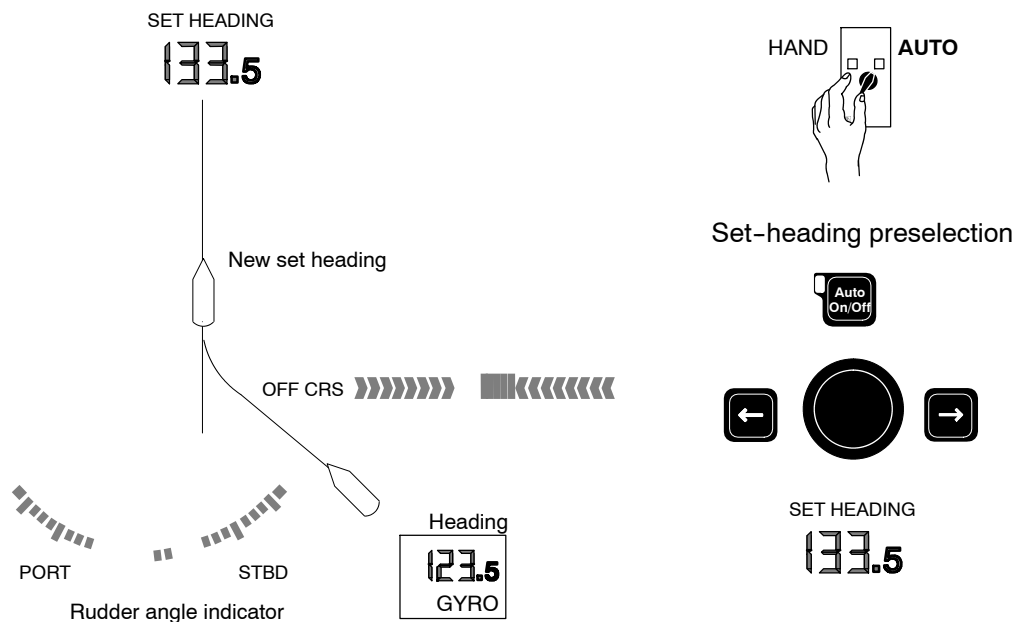


Fig. 1-3: Heading Control with Set heading Preselection

1.3.2 Heading Control with Automatic Set Heading Preadjustment

This operating mode is useful for maneuvers where a constant heading change maneuver of, e.g. 90° is often to be sailed (fishing, towing, ferries).

The heading change maneuver is called up and executed by pressing one of the arrow keys. The direction is determined by the appropriate arrow key.

The heading value (e.g. 90°) is superimposed on the current set heading and processed cyclically.

The heading value can be set via the **FIX TURN** parameter list of the pilotstar configuration (range 10° - 180°).

1.3.3 Heading Control with a Preceding Set-heading Transmitter, REMOTE Operation

This operating mode can only be realized in conjunction with a navigation system.

With this, the set heading is determined by the navigation system and transmitted to the PILOTSTAR D via a serial interface.

The PILOTSTAR D performs the heading control. The status field **EXT.CRS** is faded into the LCD display.

During this operating mode, the manual set-heading input (rotary knob or arrow keys) and change-over to the operating mode TRACK are not possible.

A further possibility is the integration of PILOTSTAR D into an external track guidance system. With this, the track heading and the track deviation are converted into a set-heading information and transmitted to the PILOTSTAR D.

1.3.4

Track Control

The operating mode of track control presupposes the connection of an external navigation receiver (e.g. GPS) to the autopilot.

Within this system conception, the navigation receiver (for APA and APB telegram transmission) transmits track section data of a planned route to the autopilot. Any track section is indicated as a track course and executed in terms of control engineering.

If XTE telegram transmission is used, the operation will be different. First of all, the new track course is to be read off the navigation receiver and to be adjusted on the PILOTSTAR D via the rotary knob.

The following example shows a route consisting of 3 waypoints and 2 track sections. Planning of such a route can only be made via the navigation receiver (see manufacturer's handbook).

On reaching the WOP circle, the autopilot receives the track course preselection for the next track section. This state is indicated via the text line and, after acknowledgement, accepted as a new track course. At this moment, the ship starts turning with the preselected rate of turn into the next track section.

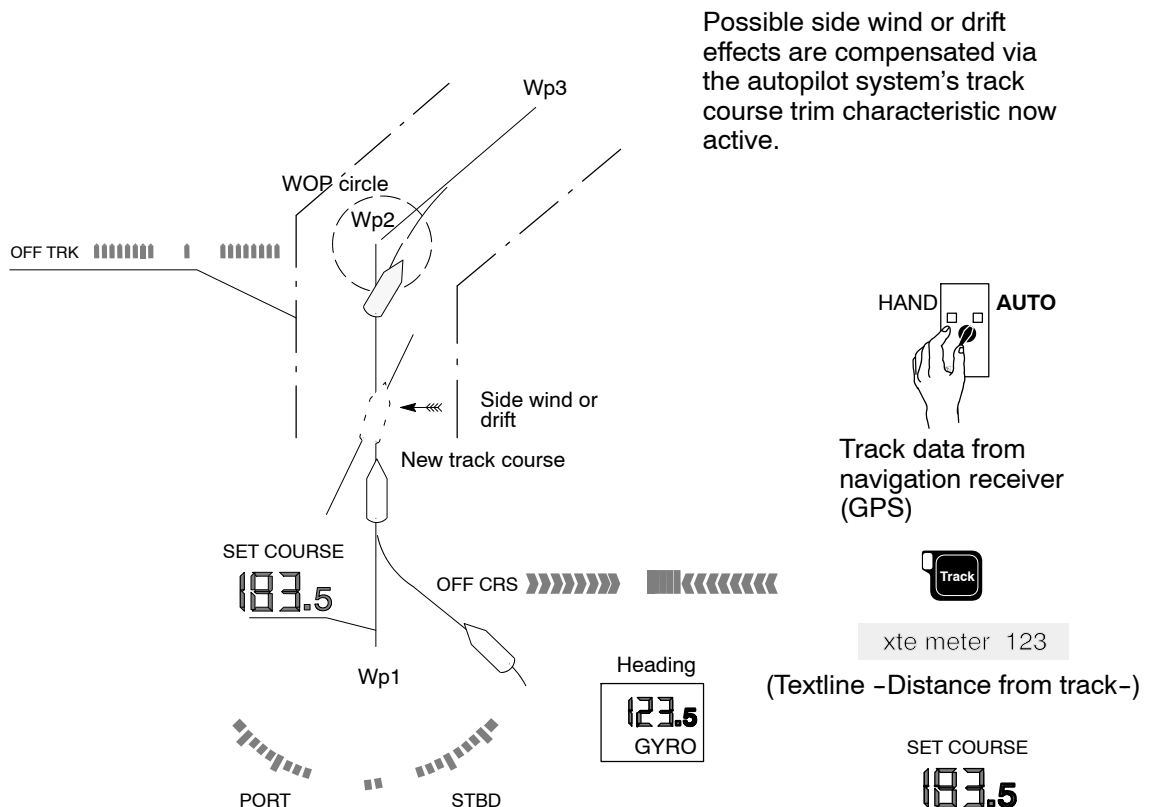


Fig. 1-4: Track Control



1.4

Heading and Sensor Monitoring

The autopilot is equipped with an extensive monitoring electronics. In case of trouble, audible and visual alarm will be released.

The availability of the heading sensors or the function of the steering gear, etc., is continuously monitored.

As soon as the adjusted safety threshold, e.g. **OFF COURSE** (OFF heading) monitoring limit, has been exceeded, an alarm is released on the operator unit. A plain text faded into the text line indicates the cause; an immediate measure can be initiated.

The malfunction indication is treated with highest priority, i.e. a plain text already indicated in the info line will be overwritten.

Error states – as long as not eliminated – are stored by the monitoring electronics and treated as errors that are to be acknowledged (*Alarm LED* alight).

In case a serious error occurs, such as failure of the heading sensor (GYRO FAIL or MAG FAIL), the last heading is stored, the set heading is caused to follow up correspondingly. This monitoring function prevents an uncontrolled ship's motion; the user has the time for changing over to an alternative heading sensor (e.g. magnetic compass) or to manual control.

1.5 Function of the TRIM MODE (TRM)

The TRIM Mode is a so called “Working Mode” and could be essential to ships with low speed, as there could be trawlers, towboats (tugs) or other work boats.

The Trim Mode is nearest a heading control function with specific operating features. These operating features can be used, but is no necessity.

To adjust this TIM MODE it is necessary to define the parameters first. Parameters are: TRM-yawing, TRM-rudder and TRM-counterrudder.

To establish criteria it is to decide if it is necessary to apply a heading control with a high TRM-rudder amplification for lower speeds or if there is an asymmetric load to the ship with manual steering possibility and a self-affected constant-rudder function.

See also section 2.2.10 for operating the TRIM function

1.5.1 Recommended applications

Tagging a load with low speed and less manoeuvre

There should be a heading control without manual intervention.

The parameter are pre-adjusted to a high rudder amplification together with a lower ship's speed.

In this application the features of the second set of parameters are used only.

Rudder limit is cancelled to work with greater rudder angles.

Trawlers with an asymmetrical load caused by a trawl net and manoeuvre operation

Application of the parameter TRM-rudder (Trim rudder).

The parameters are adjusted in that manner that the heading control will steer the ship with a small rudder amplification and the rudder can be trimmed additional manually (depending on the specific requirement).

The part of manual rudder setting is added to the part of heading control rudder setting and is achieved as constant rudder.

The drawback of the normal heading control is, that there will be a higher integral part of the heading control which often interferences whilst heading changes, it means that the heading changes are too slow.

In the TRIM Mode this integral part is switched off.

With the parameter TRM-rudder as an alternative of this integral part it is possible to react faster if it is necessary (change of loads or manoeuvres) and the heading control stays effective in the background.

The TRM-rudder function can be turned-off by pressing the arrow-keys simultaneously.

Turning-off the integral part of the heading control

Initial state: Heading control is used according to "Tagging a load with low speed and less manoeuvre".

Task: The integral part on the control function shall be turned-off.

- Activation of the Trim Rudder with the arrow-key to 1° and back to 0°.

By this the actual integral part is turned-off and can initialize itself after a heading change again.

Override the heading control

With the TRM-rudder function a heading deviation (Starboard or Port) from the set heading can be forced. This can be achieved by an overriding of the heading control in that manner that a ship can deviate from the actual set heading in a range of $\pm 10^\circ$ if additional change manoeuvre are necessary.

The adjusted set heading value is lasted at the display as a reference, this value is automatically active after turning-off the TRIM function.



Turning-off the TRM-rudder (integral part) by pressing the arrow keys simultaneously will lead to a uncontrolled reaction of the ship (heading) therefore it could be better to set the TRM-rudder function to zero step by step.

1.5.2 Summarization

Switching-over from heading control to TRIM MODE

- Trim parameters are activated.
- Rudder limit is turned-off
- Heading control (with all features) is active.

TRM-rudder is applied

- Adjusting the trim rudder in 1° steps by the arrow keys.
- Adjusted trim rudder value is added as a constant value to the heading control value.
- The integral part of the heading control is lastest turned-off.
- The rudder limit is lastest turned-off.

Turning-off the TRM-rudder

- Pressing the arrow-keys simultaneously and the manual TRM-rudder is turned off.
- The integral part of the heading control function is enabled.

1.6 System Extension

The connection unit of the autopilot permits a simple and quick system extension; further system PCBs are not required (see Fig. 1-5).

1.6.1 Main and Secondary Operator Units

In addition to the main operator unit, 2 further operator units of the same type can be connected to the connection unit of the autopilot as secondary steering stations. A "Take-over System" permits change-over between the operator units. Within the secondary operator units, access to the ship-specific parameters (CONFIG. on/off) is not possible.

1.6.2 Tiller

The autopilot can be equipped with up to 3 tillers.
Any combination as follow-up or non-follow-up tillers is possible.
The following tiller variations can be made:

- FU tiller (**F**ollow-**u**p tiller)
- NFU tiller (**N**on-**f**ollow-**u**p tiller).

For tiller control, the steering mode selector is to be set to position "AUTO".

The tillers are provided with a **Take-over** function.

If e.g. the key "MAN" is actuated on a tiller, all the other operator units – independently of their operating mode up to now – change over to the operating mode STANDBY.

The HEADING is declared to be the SET HEADING, the tiller control is released.

By actuating the key "AUTO", the tiller control is de-activated, the main operator unit is active.

Option

External Status Indication.

An external status indication shows the activation of a tiller within the steering control.

1.6.3 Central Alarm System

The autopilot provides each an alarm output and alarm input for the integration into a central alarm system.

This Central Alarm System is used to manage all alarms from different devices from a central position.

The first intention is to mute the acoustical sound from a device and look for the cause of alert afterwards by local examination at the respective position.

The alarm muting is solved bidirectional, that means an alarm which is local cancelled will be muted also on the Central Alarm Panel and vice versa.

The Pilotstar D must be configured to 'RELAY ALARMS' according to section 4.7, sub-item 10.

The 'Relay Alarm' output designated as 'RELAY AUTO FAIL' is summarizing all acoustical/optical alarms of the Pilotstar D to transfer a message to the Central Alarm Panel. The 'Quit' signal from the Central Alarm Panel is connected to the operation panel of the Pilotstar D. During local alarm quit a 'Relay Alarm' contact (designated as Tiller ON) is activated and connected to the Central Alarm Output.

An summarize of all alarms is shown in section 2.6.3

Exceptions:

Synchronize call = means Step systems connected

New track call = means a track changing message

Checkdata call = means there is a configuration mismatch

1.6.4 Rudder-angle Indicator

On the junction PCB of the connection unit, two outputs are provided for connecting up to two analog rudder-angle indicators.

1.6.5 Multifunction Indicator (e.g. Raytheon Anschütz Digital Navigation Data Indicator)

The connection unit is equipped with a serial output for the connection of a multifunction indicator (RS232 output) (Configuration D-REP).

In this connection, the Raytheon Anschütz digital navigation data indicator offers itself as a multifunction indicator.

The digital navigation data indicator permits the following indications:

- Heading indication
- Set heading indication
- Log information (only in conjunction with a log sensor)
- Rate-of-turn set value.



1.6.6 Connection of a Steering Repeater

As an alternative to the digital navigation data indicator, this serial output can also be used for connecting an Raytheon Anschütz steering repeater with specific Software (RS422 output) (Configuration A-REP).

For this, the compass change-over (GYRO / MAG) is taken into consideration, i.e. the steering repeater is automatically connected to the selected compass type.

1.7 Technical Data

1.7.1 Electrical Data / Ambient Conditions

- Operator unit
 - Power consumption: 3.5W
 - Supply via connection unit: 5V DC
 - Type of enclosure: IP 44 or IP 56
 - Ambient temperature: - 10° to + 70°
- Connection unit
 - Power consumption with the use of one operator unit: 12W
 - Supply, with reverse current protection: 10 to 36V DC
 - Type of enclosure: IP 21
 - Ambient temperature: -10° to + 50°
 - Relative humidity of air acc. to IEC 945: 93% with 40° C
 - EMC: see Declaration of conformity
 - Radio interference suppression acc. to IEC 801: Limiting value class B
 - Output for steering gear
 - Switching output (2x): 24V DC max. 48W
110V DC max. 48W
 - Analog output, floating (2x)
 - Max. rudder set value: +/- 10V DC / 5mA
 - Variable voltage value for max. rudder set value

PILOTSTAR D

- Interfaces for possible sensors
 - Gyro compass with transmission system: Raytheon Anschütz course bus system
Raytheon Anschütz step system
1/6° Step-system
 - Magnetic compass with transmission system: Raytheon Anschütz scanning sonde
Fluxgate sonde with sine/cosine DC voltage
Electronic fluxgate compass with NMEA 0183 interface
- Ship's log: 200 pulses or with NMEA 0183 interface
- Position receiver (APA, APB, XTE telegram type) NMEA 0183, RS232
- Interfaces for the system extension
 - Max. 3 tillers possible: FU tiller
NFU tiller
 - Max. 2 rudder angle indicators: ±10V DC, 2.5 mA each
 - Max. 3 operator units: 1 main unit, 2 secondary steering units
- Floating alarm and signal outputs for supplying an external signal transmitter
 - Alarm outputs (Relays output): AUTO FAILure (automatic faulty)
Power FAILure (voltage supply faulty) STEERING FAILure (steering control faulty)
OFF HEADING (heading error with regard to gyro compass)
HEADING MONITOR (heading error with regard to magnetic compass)
- Status (Relays output) for TILLER ON status or for ALARM RESET

- Signal output:
 - Serial output RS232
for Raytheon Anschütz digital
navigation data indicator
(set heading, actual heading,
speed)
 - or
 - Serial output RS422
for Raytheon Anschütz steering
repeater (with spec. Software)
- Feedback unit
 - Supply via PILOTSTAR D: $\pm 15V$ DC
 - Type of enclosure: IP 56
 - Ambient temperature: -25° to $+55^{\circ}$

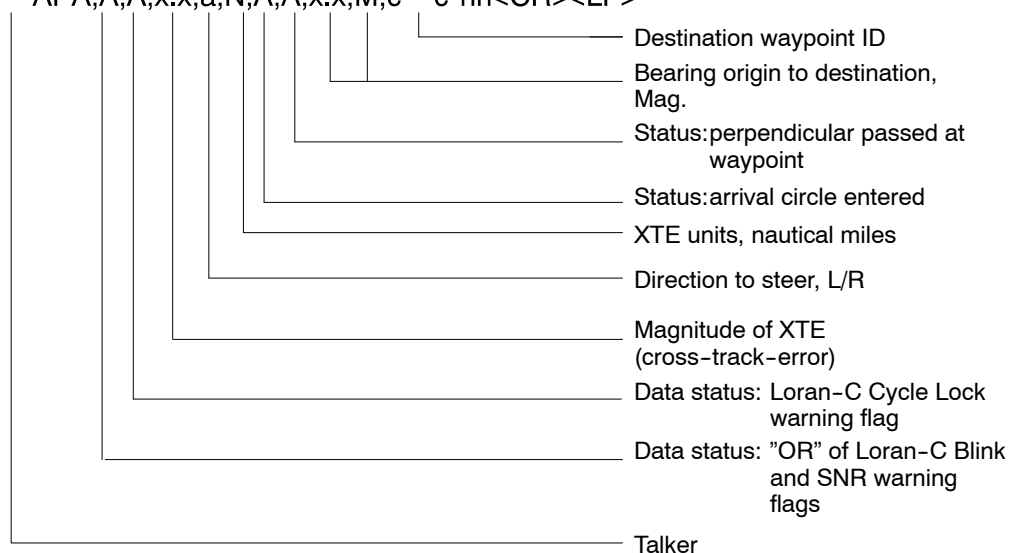
1.7.2 Interface Description acc. to NMEA 0183, Version 2.1 October 1997

1.7.2.1 Input Interfaces

- NMEA 0183 Format APA

APA $\Rightarrow$ Autopilot Sentence "A"

\$--APA,A,A,x.x,a,N,A,A,x.x,M,c--c*hh<CR><LF>

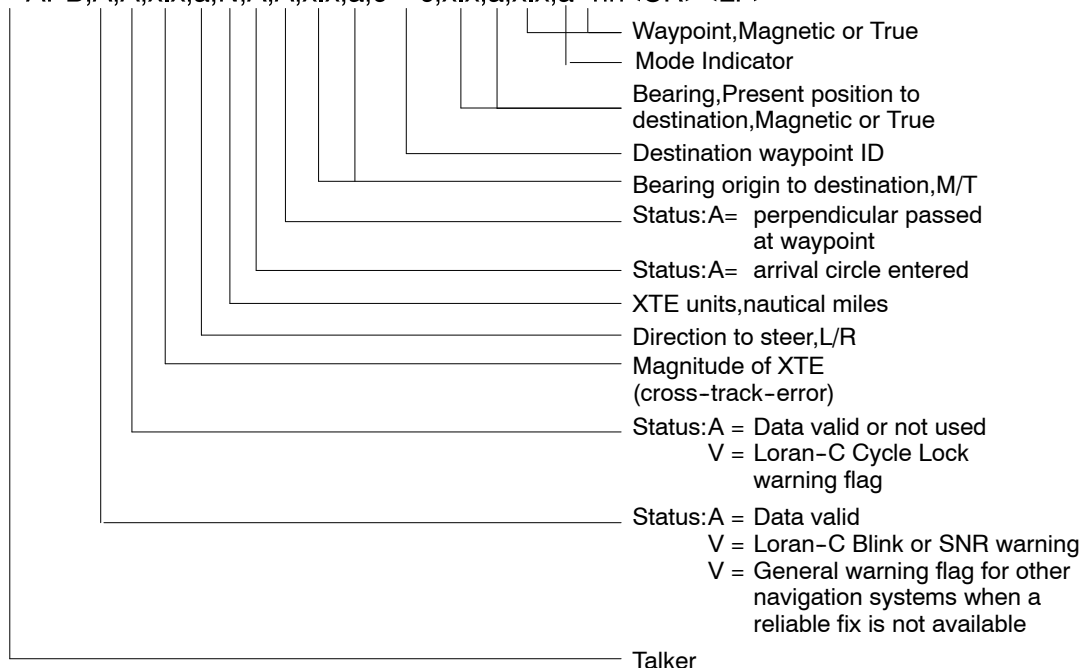


PILOTSTAR D

- NMEA 0183 Format APB

APB ⇒ Autopilot Sentence "B"

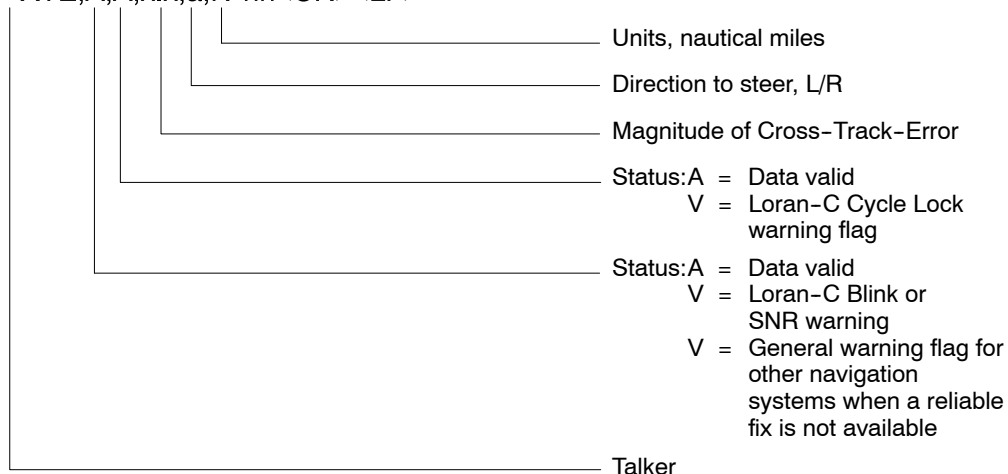
\$--APB,A,A,x.x,a,N,A,A,x.x,a,c--c,x.x,a,x.x,a*hh<CR><LF>



- NMEA 0183 Format XTE

XTE ⇒ Cross-Track-Error, Measured

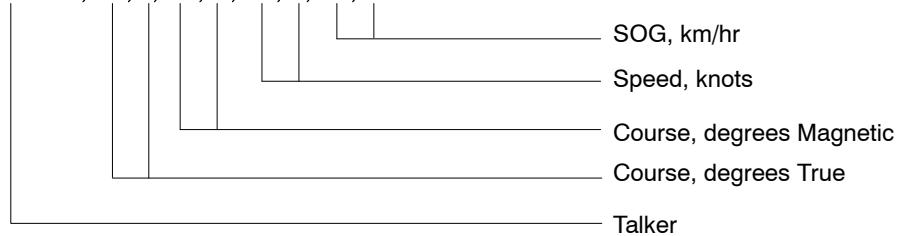
\$--XTE,A,A,x.x,a,N*hh<CR><LF>



- NMEA 0183 Format VTG

VTG ⇒ Course Over Ground and Ground Speed

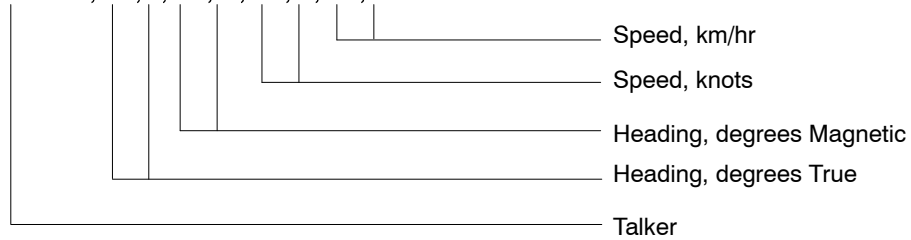
\$--VTG,x.x,T,x.x,M,x.x,N,x.x,K*hh<CR><LF>



- NMEA 0183 Format VHW

VHW ⇒ Water Speed and Heading

\$--VHW,x.x,T,x.x,M,x.x,N,x.x,K*hh<CR><LF>

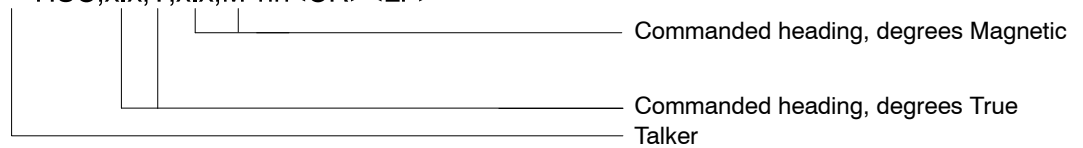


- NMEA 0183 Format HSC

HSC ⇒ Heading Steering

This telegram allows only a definite heading command of less than 180° .

\$--HSC,x.x,T,x.x,M*hh<CR><LF>



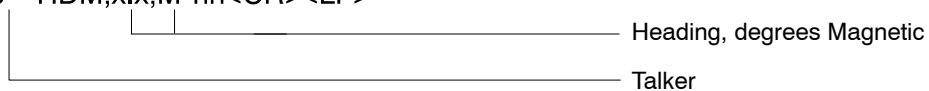
- NMEA 0183 Format HC HDM

HDM ⇒ Heading, Magnetic (software version E03.00)

HC ⇒ Compass, Magnetic (upper software version E03...)

(E03.00)

\$--HDM,x.x,M*hh<CR><LF>



(E03...)

\$HCHDM,x.x,M*hh<CR><LF>

Heading, degrees Magnetic
Talker

- NMEA 0183 Format HDT

HDT ⇒ Heading True (9600 Baut Rate, cycle ≤ 100ms)

\$HEHDT,x.x,T,x*hh<CR><LF>

Heading, degrees True
Talker

1.7.2.2

Output Interfaces

- NMEA 0183 Format HEHDT

HEHDT ⇒ Gyro-Compass sentence

\$HEHDT,x.x,T*hh<CR><LF>

Checksum
Degrees true
Heading
Talker

- NMEA 0183 Format HCHDT

HCHDT ⇒ Magnet-Compass sentence

\$HCHDT,x.x,T*hh<CR><LF>

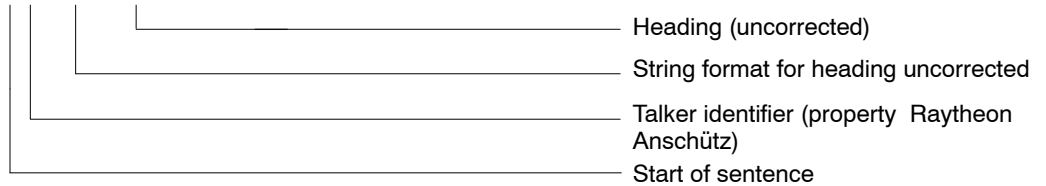
Checksum
Degrees true
Heading
Talker



- Property NMEA 0183 Format PADRT

PADRT ⇒ Rate of turn limit (adjusted on autopilot operator panel)

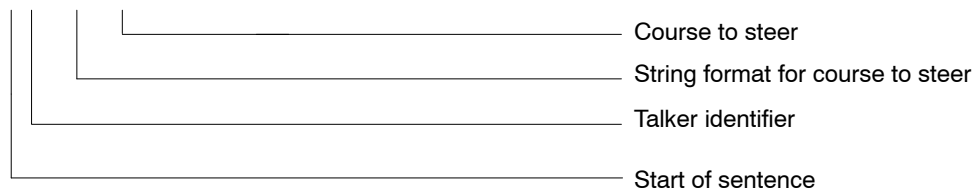
\$PADRT,xxx.x<(CR)><(LF)>



- Property NMEA 0183 Format IICTS

IICTS ⇒ Course to steer

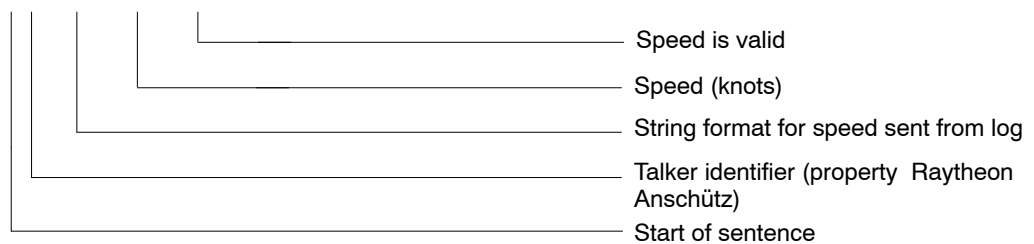
\$IICTS,xxx.x<(CR)><(LF)>



- Property NMEA 0183 Format PASVW

PASVW ⇒ Speed (valid, if LOG failure)

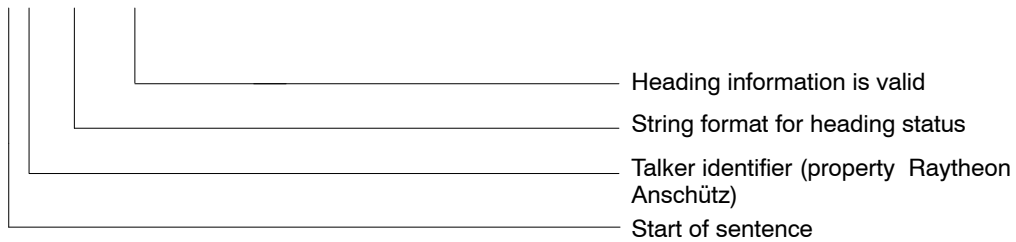
\$PASVW,xx.x,A<(CR)><(LF)>



- Property NMEA 0183 Format PASHE

PASHE ⇒ If heading is valid

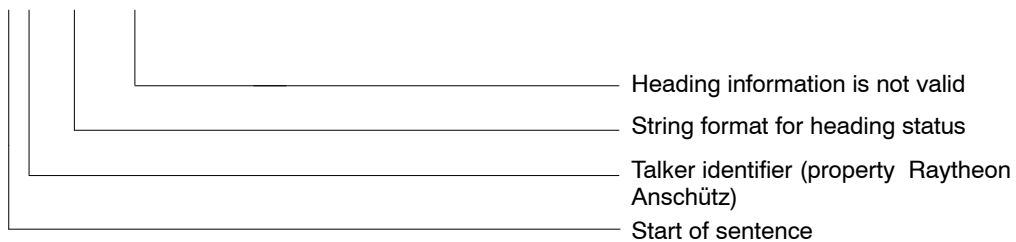
\$PASHE,A<(CR)><(LF)>



- Property NMEA 0183 Format PASHE

PASHE ⇒ If heading is not valid

\$PASHE,V<(CR)><(LF)>



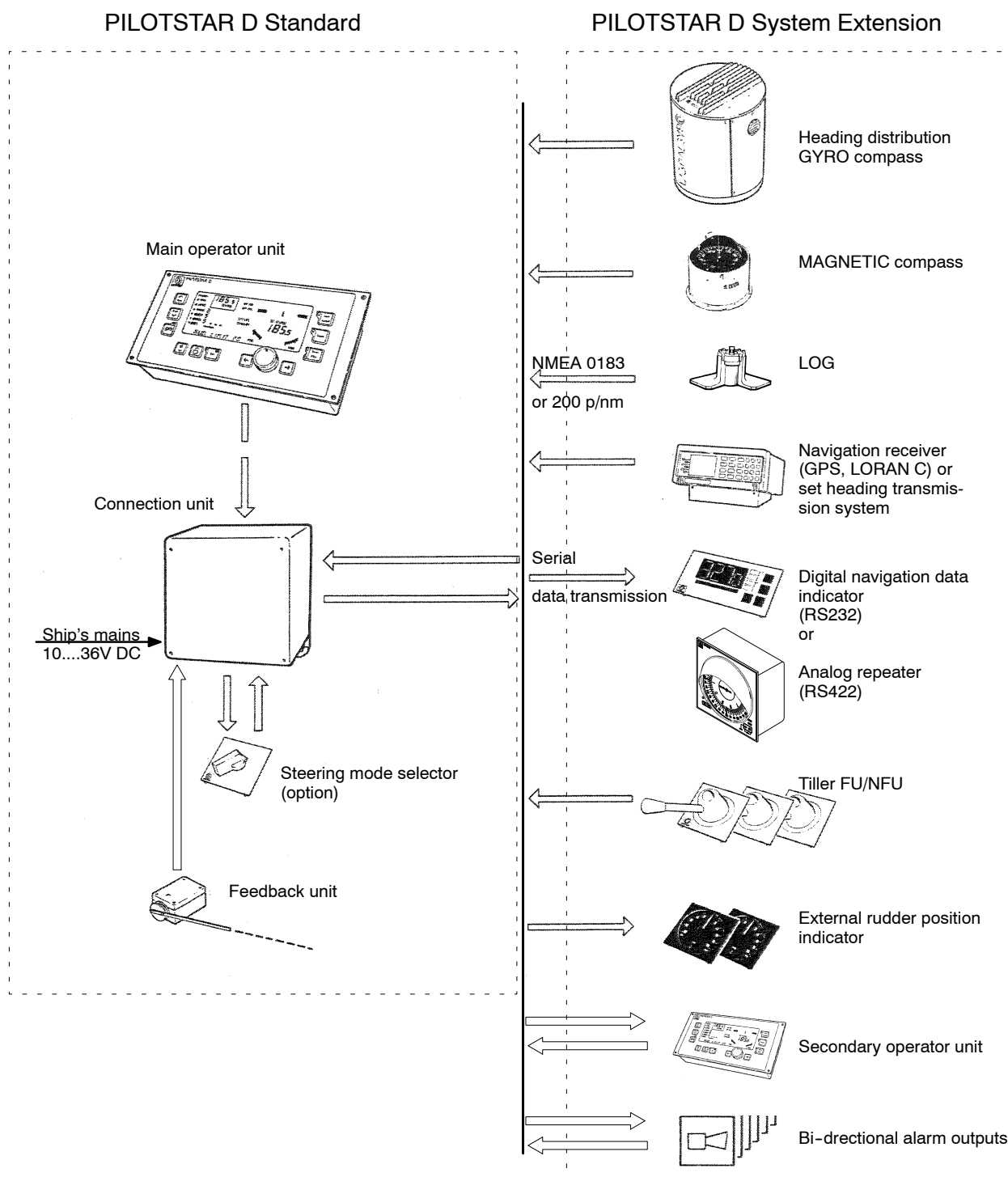


Fig. 1-5: The PILOTSTAR D System Concept

PILOTSTAR D

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2 Operating Instructions

2.1 SAFETY NOTES

ATTENTION



In opened devices or desks, voltages representing a risk of electric shock are applied.

- SAFETY INSTRUCTION -

As a matter of principle, the system is to be made dead when installation work is performed on the equipment as well as during disassembly/assembly of components or during alteration of the circuitry.

2.1.1 Ship's Safety

According to the GERMAN LLOYD and to other regulations, the autopilot has been classified as a **SECONDARY STEERING SYSTEM**, i.e. without redundant installation nor internal redundancy. A MAIN STEERING SYSTEM, however, e.g. manual control, must be installed twice and without reactive effects.

In the course of this description, a system component designated as a main and secondary operator unit is often referred to in the text.

The significance of these operator units and the autopilot function connected therewith is always to be considered as a **SECONDARY STEERING SYSTEM** within the complete system!

Our devices are manufactured and tested in accordance with an international quality assurance system (ISO 9001). Nevertheless, errors cannot fully be excluded.

The autopilot is equipped with an extensive monitoring logic, by means of which errors or failures within the autopilot system or connected sensors can be recognized. Alarm signalling is audible or visual via the operator unit. Floating contacts permit connection to a central error signalling such as e.g. NAUTOALARM.

2.1.2 Checks to be made before any Putting into Operation

In order to ensure correct functioning of the autopilot, faultless operation of the following systems and devices is required:

- Power supply
 - for the equipment concerned
 - 10 ... 36V DC for the autopilot
- Steering gear and steering control system
- Sensors and appertaining transmission equipment
 - Gyro compass
 - Magnetic compass / fluxgate compass
 - Log
 - Navigation receiver

2.1.3 Turning Behaviour in Case of Heading Change

In case of a heading change, the ship follows automatically the user input direction of the rotary knob (see section 2.2.6.1).

The turning behaviour with preselected rate of turn depends on

- the ship's initial turning behaviour and
- the adjusted ship-specific and current parameters.

When the ship starts turning, the rate of turn may exceed the preselected rate of turn.

2.1.4 Checks to be made before Departure and during the Voyage

- Compare the **heading indication** in the operator unit with the **compass heading**.
- The operational parameter adjustments have been made acc. to experience (see Annex -2).
- If the ship is now running in suitable waters, change-over to autopilot control can be made.

The steering mode selector is to be set to position AUTO.

The operating mode of heading control is now effective.

If another operating mode is wanted, this can now be selected.

2.1.5

Change-over to another Heading Sensor

Change-over to another heading sensor may result in a **considerable** SET HEADING deviation.

In order to avoid unintended reactions of the ship on changing over, the set heading is equated with the heading.

The unintended set heading deviation must be corrected via the **PORT/STBD** keys or via the **rotary knob** (see Chapter 2.2.6).

	Indications	Remark/Notes
1	Calling up the Parameter	

2.2

General Operation and Pre-conditions

The following chapters describe each key function, the corresponding indication and the effects on steering control.

For actively testing certain operator actions on the operator unit, a completely installed autopilot is required here.

The steering mode selector must be set to position **AUTO**.

ATTENTION



For the first installation, the operator must ensure the following safety-relevant measures:

- Ship made fast
- Steering gear or steering linkage is freely moving, and correctly covered or protected against access, resp.
- Rudder blade freely moving.

The ship's mains is connected (POWER ON)

NOTE



The membrane keyboard must **never** be operated with a pointed object (ball-point pen, pencil etc.) !

For cleaning the membrane keyboard and the LCD display, a commercial acid-free agent is to be used only.

Annex -1 shows the complete operator surface of the operator unit.

2.2.1 Explanation of Symbols Used



Key actuation



LED *flashing*



LED *out*



LED *on*



Audible signal *on*



Audible signal *off*



Status panel flashing



Index for display explanation

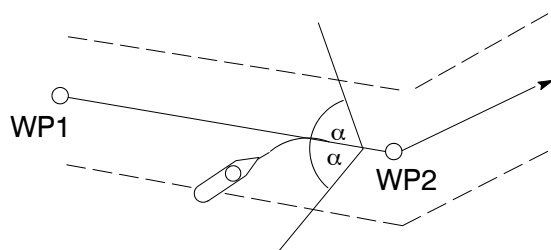
2.2.2 Prerequisite for Switching on the Operating Mode TRACK CONTROL

This operating mode presupposes certain operator actions, i.e. **track planning**, on the navigation receiver.

See manufacturer's handbook of the navigation receiver in question.

Prior to switching to the operating mode of track control, the following recommendations should be taken into consideration:

- a) The ship must be turned into the ahead direction with regard to the track (angular range approx. $\alpha \approx 60^\circ$).



- b) Before switching on the track control, the ship should be within the track monitoring limits (see OFF TRK bar graph indication). Ascertain the track deviation with regard to the track heading by means of the navigation receiver.
If a large position difference is found, it is recommended in this situation first of all to approach the track (within the monitoring range), with heading control or by hand control.

2.2.3

Putting into Operation

- With connecting the ship's mains supply (ship's mains fuse ON), the PILOTSTAR D is ready for operation. The following survey shows the possible operating conditions / operating modes.

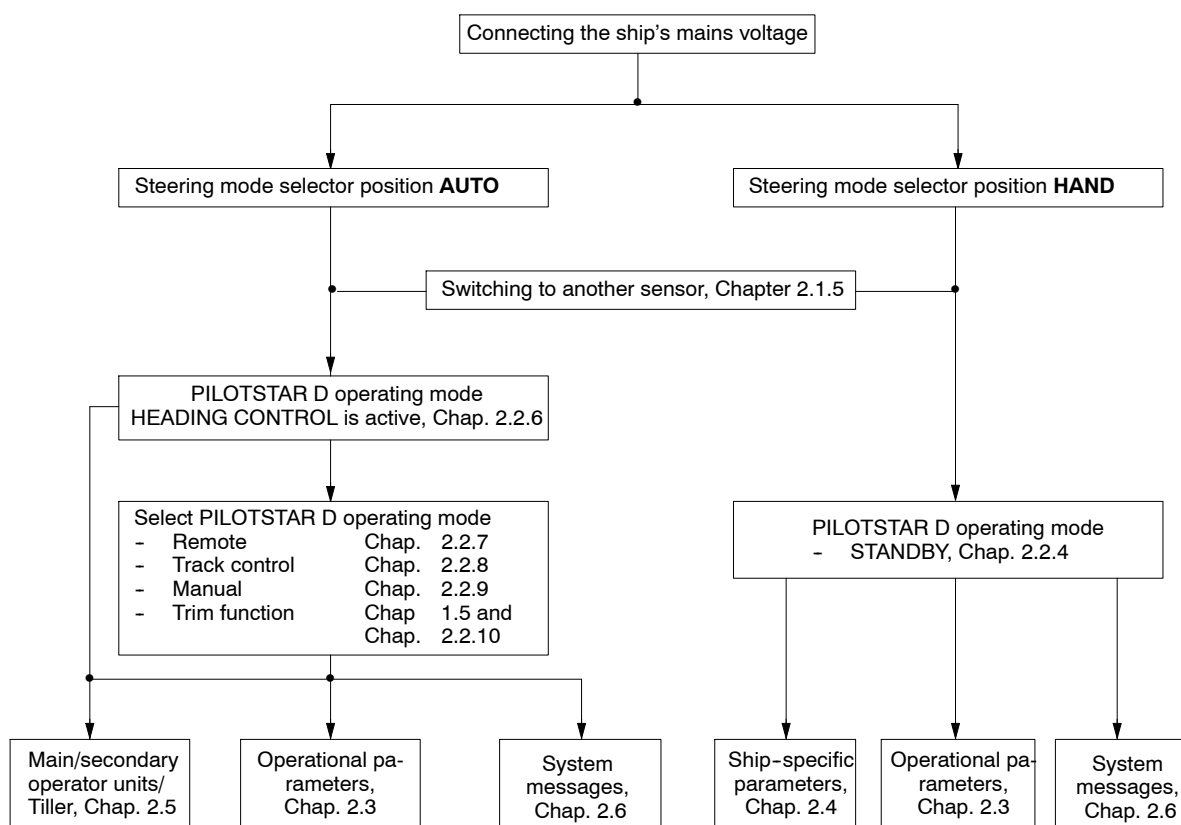


Fig. 2-1: Survey of Possible Operating Conditions / Operating Modes

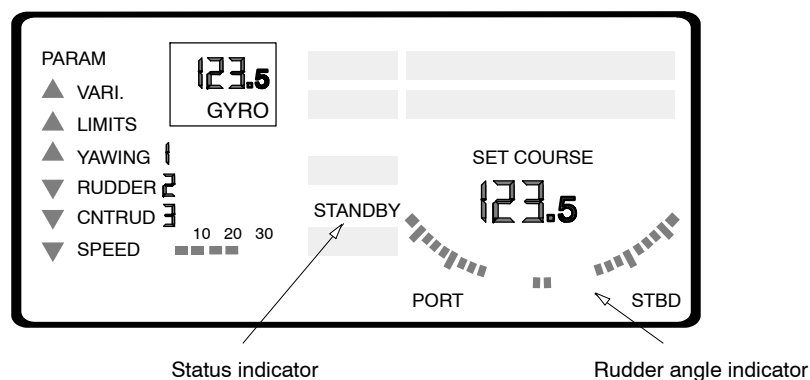
2.2.4 The Status Indication **STANDBY** is visible



- Dependent on the system type, this status indication describes the following system situation:

- The steering mode selector has been set to position **HAND**.
The autopilot and Pilotstar D -Tiller are electrically separated from the steering control system. The AUTO Led is off.
- The steering mode selector has been set to position **AUTO**.
The main operator unit is active – the AUTO LED is on.
If the tiller steering (Pilotstar D) is selected, the operation panel changes over to STAND BY Mode

- The LCD display indication is as follows



The current heading and the rudder angle indication are operated as active indications. The set heading indication is caused to follow up the heading.

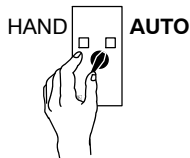
Alarm and error messages (see Chapter 2.6) appear in the text line – **silent alarm** – (no audible signalling). Exception: If heading sensor fails an optical and acoustical alarm comes up.

All operation LEDs are switched off.

- Operating parameters, as well as parameters specific to the ship itself, can be changed as required.

2.2.5

Switching on the Autopilot (Standard Equipment)



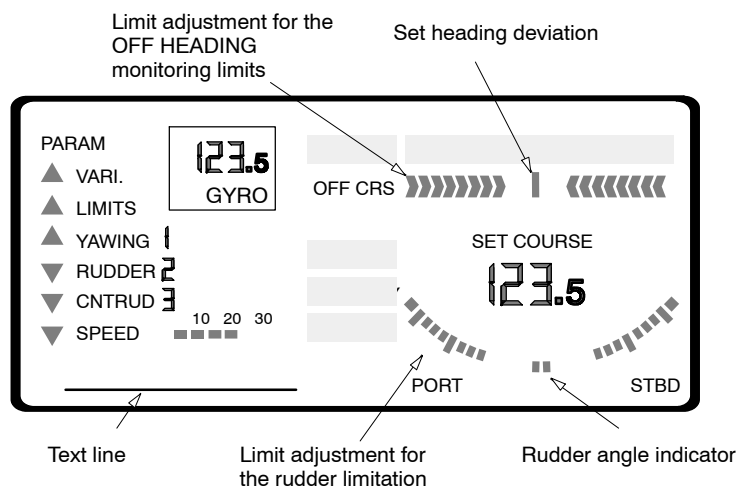
- The autopilot is activated via the steering mode selector, switch position **AUTO**.

The operating mode **HEADING CONTROL** is now active (see Chapter 2.2.6).

Change-over to another operating mode is now possible.



- The LED panel of the key lights up (GREEN).
- The LCD display indication is as follows:



The autopilot system is active; the **OFF CRS** (off heading) bar graph indication indicates the set heading deviation via the centric dynamic bar graph segment. The monitoring limits are shown as static bar graph segments.

With switching on/changing over, the **HEADING** is taken over as **SET HEADING** preselection as a matter of principle.

(Adjusting the monitoring limit for OFF HEADING, see Chapter 2.3.3.

Adjusting the rudder limitation, see Chapter 2.3.4.

Synchronization, see Chapter 2.3.6.)

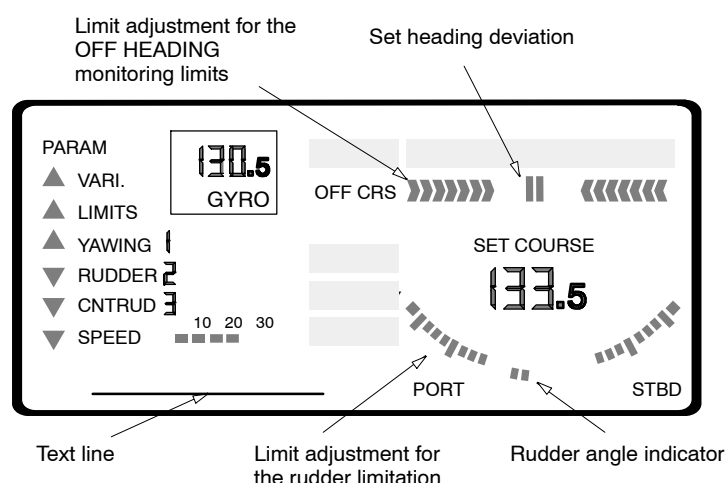
2.2.6 The Operating Mode HEADING CONTROL

- By actuating the key, the heading control is activated.

The instantaneous **HEADING** is accepted as **SET HEADING** preselection.
The ship is held on the instantaneous heading.



- The LED panel of the key is alight (GREEN).
- The display indication is as follows



Within the **OFF CRS** bar graph (off heading) indication, the set heading/actual heading deviation is described via the central display range. It is by means of this indication that the quality of heading control can be judged.

One segment corresponds to a heading deviation of 2°.

In case of a considerable heading deviation that reaches the monitoring range, an **OFF HEADING** alarm is released (audible alarm and plain text info in the text line).

The possible source of trouble may be a disturbance in the steering control circuit (for detailed information see Chapter 2.6).

(Adjusting the monitoring limit for OFF HEADING, see Chapter 2.3.3.

Adjusting the rudder limitation, see Chapter 2.3.4.

Synchronization, see Chapter 2.3.6.)

2.2.6.1

SET HEADING Change

ATTENTION

The heading change manoeuvre is initiated immediately. The ship starts turning with the preset rate of turn (**RATE OF TURN**) into the preset SET HEADING input.

During a heading change manoeuvre, the parameter value for rate of turn (ROT °/MIN) must not be varied !

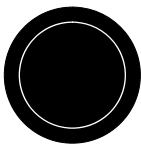
NOTE

For the rate-of-turn adjustment of ROT °/min **full**, the rate-of-turn limitation is not active.

With this adjustment, the rudder position is limited only by the rudder angle limit position RUD.LIMIT.



A new **SET HEADING** is adjusted via the **PORT/STBD** keys (1° set heading change or 5° set heading change by pressing the key constantly) or via the rotary knob (resolution 0.5°).



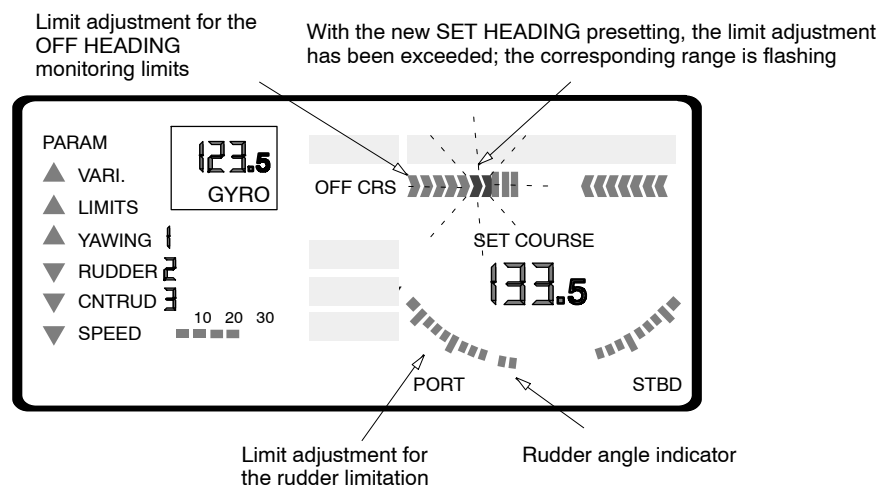
The arrow direction or the direction of rotation always corresponds to the real direction of rotation of the ship.



During a heading change manoeuvre, the **OFF HEADING** monitoring is deactivated for the period of the rough heading change.

In case of heading change the ship follows the direction of the user input – rotary knob or   keys

- In case of a SET HEADING CHANGE, the display indication is as follows:



A new **SET HEADING** initiates the heading change manoeuvre as a function of the pre-set rate of turn.

The heading direction (PORT or STBD) is realistically indicated in 2° steps by movement of the bar graph segment.

If, during the heading change manoeuvre, the limit adjustment for the monitoring limits is exceeded, this part of the bar graph indication starts flashing. The flashing tendency again decreases as a function of automatic heading follow-up.

The rudder angle indicator indicates the rudder order.

The heading change manoeuvre is terminated as soon as the HEADING indication corresponds to the **SET HEADING** indication.

The **OFF HEADING** monitoring is activated.

The graph bar is in the centre range of the permissible heading monitoring limits.

2.2.6.2

Automated SET HEADING Change (FIX TURN)

The automated SET HEADING change is only possible when in the Heading Control mode of operation.

ATTENTION



The heading change maneuver is initiated immediately.

The ship begins to turn to the newly set SET HEADING from the previously set R.o.T.

The parameter value for the R.o.T. (ROT °/MIN) must not be changed during a heading change maneuver!

NOTE



The R.o.T. limitation is not active when the R.o.T. setting ROT °/min is set to **full**.

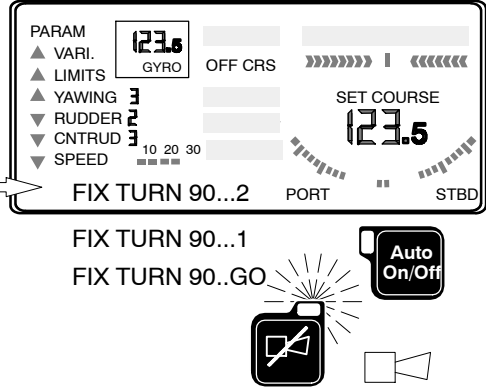
At this setting, the rudder position is only limited by the rudder position limit setting RUD.LIMIT.

This function of this special characteristic can be switched ON or OFF via the parameter administration of the ship (refer to Chap. 2.4).

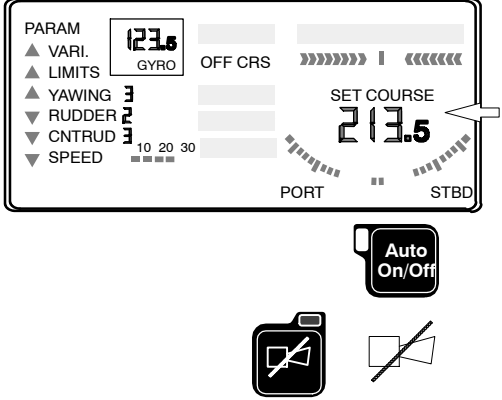
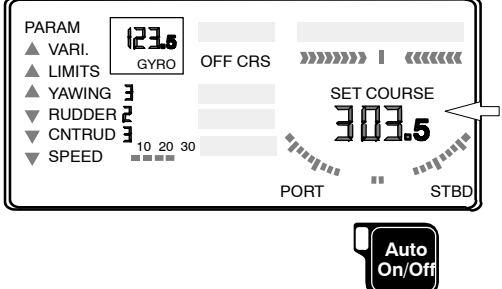
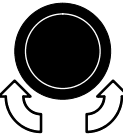
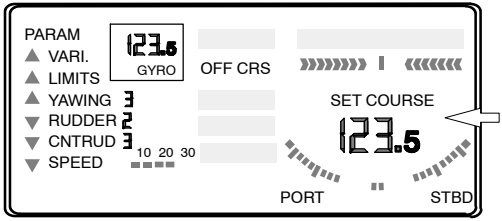
- Switched On

At this setting, a range between 10° and 180° is available.

In the following operating sequence, a 90° STBD Set Heading Presetting is to be activated and executed.

	Indications	Remark/Notes
1 Activate SET HEADING Presetting	  The display shows the heading change sequence. At the top, it displays 'PARAM' with a list of parameters: VARI., LIMITS, YAWING, RUDDER, CNTRUD, and SPEED. The current heading is 123.5. The 'SET COURSE' is also 123.5. Below this, it shows 'FIX TURN 90...2' and 'PORT'. At the bottom, it shows 'FIX TURN 90...1' and 'FIX TURN 90..GO'. There is also an 'Auto On/Off' button icon.	Press key for approx. 3s. A countdown is initiated on the text line after approx. 3s. The key must be pressed until the acoustic signal ceases to sound. Otherwise, the countdown is cancelled. The presetting is not activated.

PILOTSTAR D

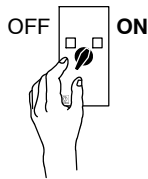
	Indications	Remark/Notes
2	Execute SET HEADING Presetting (e.g. 90° STBD)	
		The acoustic and optical signals cease. Release the key. In this example, the SET HEADING presetting is increased by 90°. The ship begins the heading change maneuver.
3	Increase SET HEADING presetting by an additional, e.g. 90° STBD?	
		Operation and dialogue as described below in 1. The SET HEADING presetting is increased by an additional 90°.
4	Cancel automatic SET HEADING presetting due to a current circumstance?	
 or 		The automatic SET HEADING presetting is immediately cancelled on turning the rotary knob or by pressing the key. The SET HEADING presetting is set to the ACTUAL HEADING.

2.2.7

Operating Mode HEADING CONTROL with a Preceding Set Heading Transmitter, REMOTE Operation

This operating mode requires a navigation system for set heading preselection (see handbook of navigation system).

REMOTE Schalter



- Set the REMOTE switch to position **ON**.
An operating mode already active is now automatically de-activated.
- The LED panel of the key lights up (GREEN).

Within the **SET HEADING** indication, the external set heading preselection adjusts itself.

The heading controller of the PILOTSTAR starts re-adjusting the HEADING acc. to the external set heading preselection.

The heading controller uses the preset parameter values and limit adjustments for the **OFF CRS** (off heading) indication and for the rudder limitation.

Heading differences will be sensed by the navigation system and passed on to PILOTSTAR D for heading correction.

Change-over to another PILOTSTAR D operating mode or change-over to a tiller is not possible now.

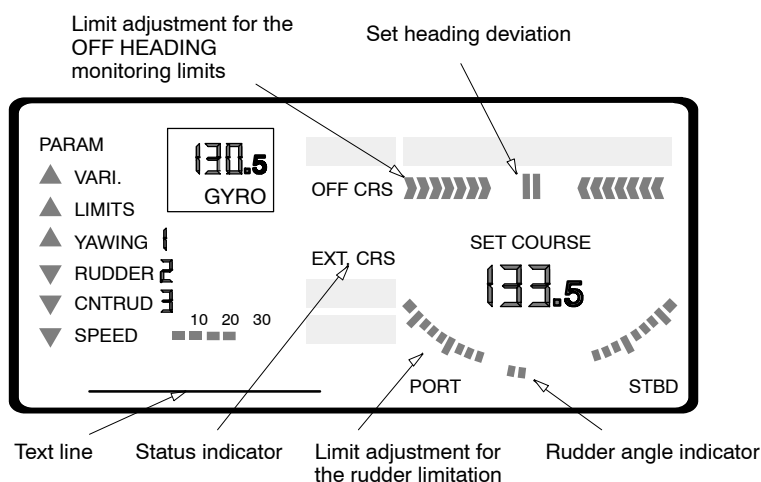
Re-adjustment of the set heading preselection via PORT/STBD keys or via rotary knob is not possible now.

Parameter actualization remains permissible.

The PILOTSTAR D sensor monitoring remains active.

PILOTSTAR D

- The display indication is as follows



With connecting the navigation system, the status indicators EXT. CRS and OFF CRS are enabled.

An external set heading preselection initiates the heading change manoeuvre as a function of the rate of turn preset on the PILOTSTAR D.

The direction (PORT or STBD) is realistically indicated by the movement of the bar graph segment in 2° steps.

If during the heading change manoeuvre the limit adjustment for the monitoring limits is exceeded, this part of the bar graph indication starts flashing.

This flashing tendency indication decreases as a function of automatic heading follow-up.

The rudder angle indicator indicates the rudder order.

The heading change manoeuvre is terminated as soon as the HEADING indication corresponds to the SET HEADING indication.

The heading deviation is sensed via the navigation system and indicated via the OFF CRS (off heading) bar graph indication of the PILOTSTAR D.

(Adjusting the monitoring limits for OFF HEADING, see Chapter 2.3.3.

Adjusting the rudder limitation, see Chapter 2.3.4.

Synchronization see Chapter 2.3.6).

2.2.8 The Operating Mode TRACK CONTROL



Do not use TRACK CONTROL under high speed condition >25kts.
Track Control has no system approval according IEC62065 (ECDIS/Autopilot)

2.2.8.1 Approaching a Track

Before changing over to the operating mode of **track control**, the track to be sailed through must roughly be reached via manual control or via heading control (Step 1) (see Chapter 2.2.6).

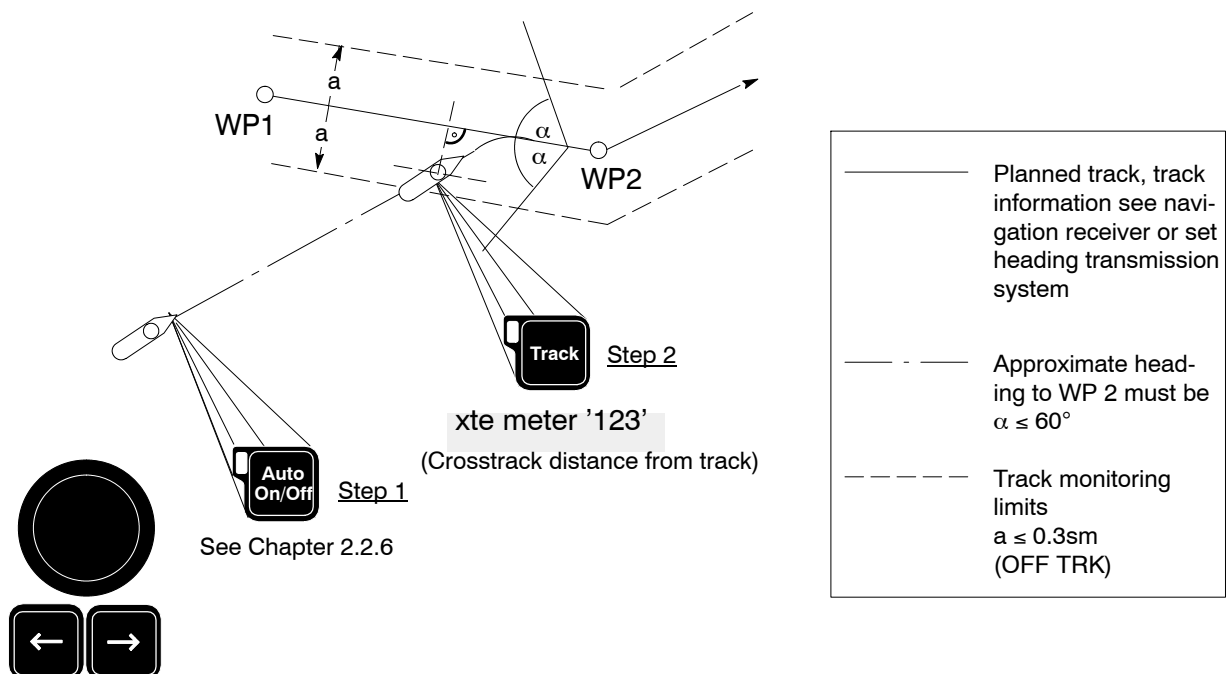
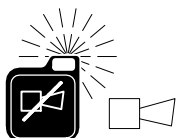


Fig. 2-2: Approaching a Track



- After approaching the track, the operating mode of **track control** (Step 2) can be activated. Actuate the key **TRACK**; the LED panel lights up GREEN. The operating mode of track control has been preselected.
First of all, the message of xte meter '123' (crosstrack distance in [m]) appears within the text line
(for approx. 3s) then appears **NEW TRACK**
The LED panel of the "Symbol" key lights up (RED).



- For taking over the track course data, the symbol key must be actuated for acknowledging.

The LED panel of the key becomes dark; the system message in the text line goes out; the audible alarm ceases.

The **SET COURSE** indication now shows the track course and will not change unless a new track is selected. The only exception will be if the navigation receiver is sending the **HSC** or **XTE** telegram sentence.

NOTE



If the track course is not acknowledged within the permissible time, exact and useful track control is no longer possible. Extreme manoeuvre are to be expected.

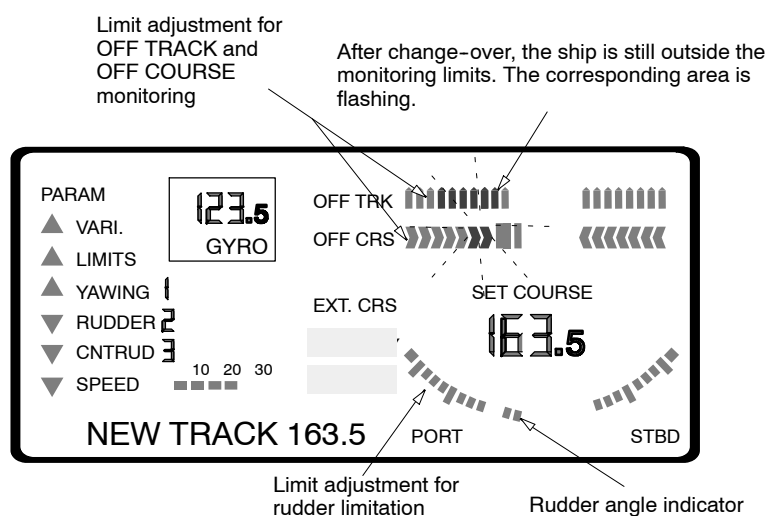
In this connection, renewed manual approach of the track is recommended.

Track control is active; the ship – dependent on the preset rate of turn (ROT/MIN) (see Chapter 2.3) – starts turning into the given track course.

Only use track changes in a range of <180° for safety reasons.

The **OFF TRACK** and **OFF CRS** (off heading) monitoring is not active until the SET COURSE presetting is reached.

- The display indication is as follows



After acknowledgement, the text line is faded out; simultaneously, the NEW TRACK course appears in the **SET COURSE** indication.

If – after change-over to the operating mode of track control – the ship is still outside the pre-defined monitoring limits (TRACK MAX and COURSE MON), these parts of the bar graph indication will be flashing.

For the **OFF CRS** (off heading) indication, one flashing element corresponds to a set heading trim deviation of 2°.

The flashing tendency indications diminish as a function of automatic track follow-up.

The track run-in phase is terminated as soon as the track deviation and the heading deviation are within the preselected monitoring limits.

The **OFF TRACK** monitoring is now active.

The set course trim is indicated by the centre deflection of the **OFF CRS** bar graph indication by 2° steps. The set course trim describes the course deviation within the monitoring limits.

Dependent on the current drift and weather condition, heading fluctuations appear within the indication which will be compensated via the track controller.

The set course trim may show values in the range of $\pm 30^\circ$.

The *track deviation* is indicated by drifting of the **OFF TRK** bar graph indication.

If a track deviation exceeds the monitoring range, **OFF TRACK** alarm is given (audible alarm and plain text information in the text line).

The possible causes are as follows (see Chapter 2.6):

- a too strong drift that can no more be corrected by off course trim of 30° or when (after change-over to operating mode **TRACK**) the ship is outside the track monitoring limits.
- if change-over to a new track section is initiated too late (see Chapter 2.2.8.1)
- when there is a defect in the steering control circuit.

The rudder angle indicator indicates the rudder order (2° per step).

(Adjusting the monitoring limits for OFF CRS, see Chapter 2.3.3.

Adjusting the monitoring limit for OFF TRACK, see Chapter 2.3.2.

Adjusting the rudder limitation, see Chapter 2.3.4.

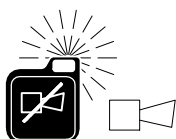
Synchronization see Chapter 2.3.6).

2.2.8.2 Track Change

The track change to the next track section of a route is to be initiated via the external navigation system.

- Change to a new track section of the route

NEW TRACK... Within the next line, the message **NEW TRACK** appears.



The LED panel of the "Symbol" key is flashing (RED); an audible message is released.

On actuating the "Symbol" key, the **NEW TRACK** course preselection is taken over as a set course preselection for the autopilot. The SET COURSE indication shows the new track heading.

The LED panel of the "Symbol" key becomes dark; the audible message ceases. Dependent on the preselected rate of turn, the ship starts turning into the next track section.

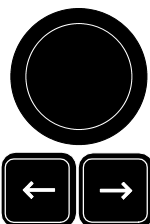
If the track change manoeuvre **cannot** be initiated within an adequate time, an exact track control is no longer possible. The ship will continue on the still valid track course of the former track section, thus leaving the planned route. The audible and visual signalling remains in existence until a decision is made, i.e.

- Acknowledgement and, therefore, acceptance of the new track section data, or
- Change-over to another operating mode.

2.2.8.3 Approaching a Track (Position Receiver with XTE Transmission)



xte meter '123'
crosstrack distance [m]



If use is made of a position receiver with XTE transmission, no track course transmission takes place .

In this case, the track course is to be read off the position receiver and to be adjusted on the PILOTSTAR D manually via the rotary knob.

2.2.9

The Operating Mode MANUAL CONTROL (DODGE Function)



- On actuating this double-function key for the **first** time, the autopilot system changes over to manual control as a matter of principle.

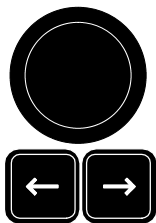
The operating modes of HEADING CONTROL or TRACK CONTROL are no longer active now.

During MANUAL CONTROL, the rudder limitation is cancelled.

The rudder value starts with a rudder position of 0 °.

The **SET HEADING** is now caused to follow up the **HEADING**.

- The LED panel **Man** lights up (GREEN).



- A new **rudder value**

The manual rudder presetting can now be adjusted via the PORT/STBD keys (resolution 1°) or via the rotary knob.

The current rudder angle is numerically indicated via the text line with the message of e.g. MAN RUDDER 10.

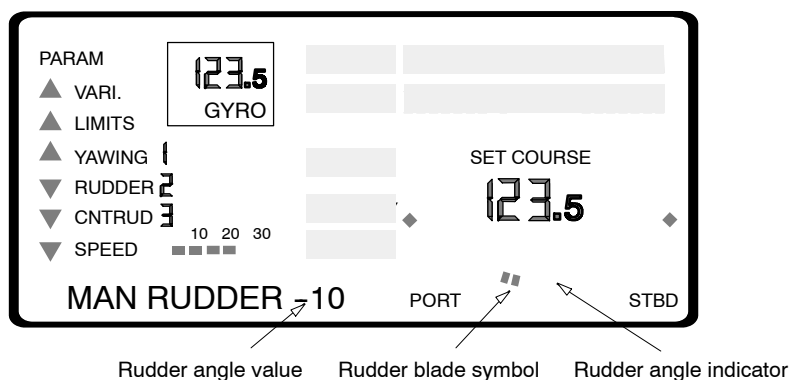
The sign describes the rudder position; "–" stands for PORT and "no sign" means STBD. The rudder order (rudder presetting) acts directly upon the steering gear.

- Automatic midship position of the rudder

If both the keys are actuated simultaneously, the rudder is automatically brought to midship position which corresponds to a rudder angle indication of MAN RUDDER 0.



- The display indication is as follows



The rudder angle indicator indicates the rudder order; the rudder angle value is currently indicated via the text line.

2.2.10 The Operating Mode HEADING CONTROL with TRIM FUNCTION (Work Mode)

The trim mode should be used when the vessel is operating at reduced speed, such as towing or fishing, due to the elimination of automatic rudder limits. It should never be used in a case where large rudder movements would cause the vessel to react violently or become unstable.



- On actuating this double-function key **twice**, the autopilot system changes over to the operating mode of heading control / TRIM.

The 2nd set of parameters becomes effective in terms of control engineering (TRIM YAW, TRIM RUD and TRIM CNT).

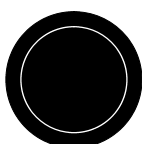


The parameters of the 2nd set of parameters belong to the operational parameters and are designated with the additional designation of TRIM... (see Chapter 2.3).

The rudder limitation is cancelled.

The instantaneous **HEADING** is accepted as **SET HEADING** presetting.

- The LED panel **Man** goes out; the LED panel **Trim** lights up (GREEN); the LED panel **Auto** lights up.
- A new **SET HEADING**



ATTENTION



The heading change manoeuvre is initiated immediately; the ship starts turning into the preselected SET HEADING.

A new **SET HEADING** is adjusted via the **rotary knob** (resolution 0.5°).

During a heading change manoeuvre, the OFF HEADING monitoring is de-activated.

If set heading data is above 180° the ship will follow the direction entered.

The vessel will NOT change over the shorter route.

- Trimming** the rudder presetting



By actuating the keys, an additional manual rudder preselection can be adjusted. It is by means of this rudder presetting, that drift effects or strong unbalances can quickly be compensated. The trim rudder position is changed by 1° steps. The heading control remains active, the automatic rudder bias component is now ineffective.

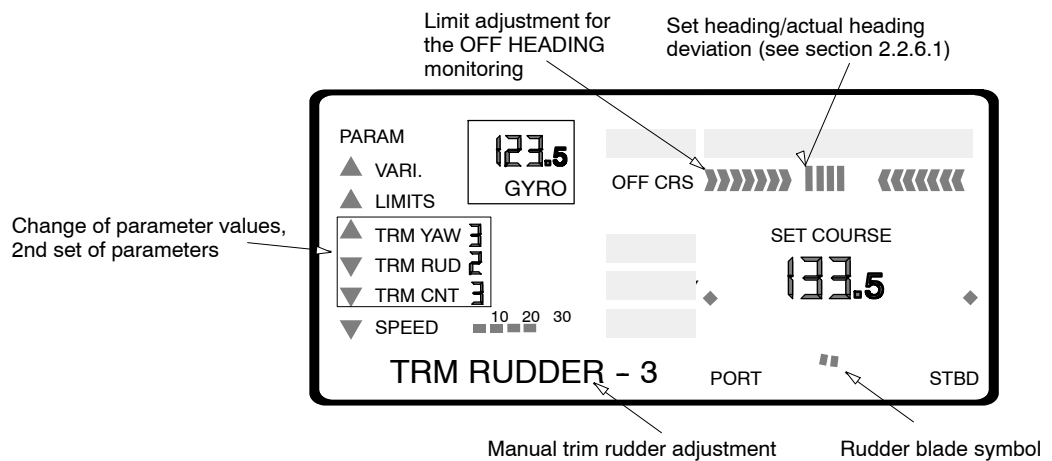
On actuating the keys simultaneously, rudder presetting will immediately be reset to 0°. Simultaneously, the automatic rudder bias component will be effective again.

The manual trim rudder value is not stored; on changing the operating mode, the trim rudder value is automatically reset to 0°.

ATTENTION

Switching back to another operating mode may bring about an unintended reaction of the ship!
For this reason, the manual rudder presetting should be reset to 0° step by step.
Only then, change-over to the intended operating mode is to be made.

- The display indication is as follows:



A new SET HEADING, dependent on the preset **2nd** set of trim parameters, initiates the heading change manoeuvre immediately.

The trim rudder order is indicated in the text line as **TRM RUDDER ...** in " ° ". The sign describes the rudder position, "-" for PORT and "no sign" for STBD.

The rudder angle indicator indicates the rudder order.
The rudder limitation is faded out.

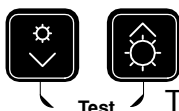
The heading change manoeuvre is terminated as soon as the HEADING indication corresponds to the SET HEADING indication.

The **OFF HEADING** monitoring is active.

The graph bar is in the centre range of the permissible heading monitoring limits.

2.2.11 Dimming of Key and LCD Illumination

- On actuating one of the keys, the key and LCD display illumination can be adjusted by steps. The main and secondary operator units are always dimmed together.

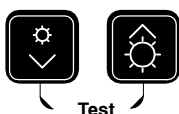


The dimming function is only active when there is **no text display in the text line**. This state is indicated by the LED of the "SET" key (LED is out; key and LCD illumination can be dimmed).

In conjunction with an active tiller, the dimming function cannot be executed.

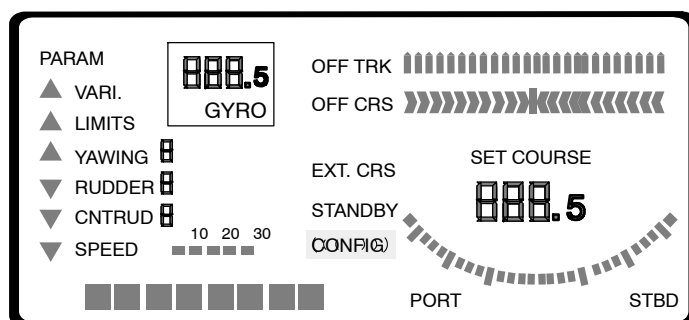
2.2.12 Lamp Test

- If both the keys are actuated simultaneously, an automatic lamp test is released (duration approx. 5 s). The lamp test can be executed with any operating mode; the current operating mode remains valid.



During the test phase

- all keys must be alight with the same intensity
- within the LCD display, the following indication must appear (all segments are activated)
- all LEDs are alight
- audible alarm is released



Version V00.00 (info appears in the text line for a short time)

Check sum...

End of test; the previous LCD display is indicated.

2.3

Varying the Operational Parameter Values

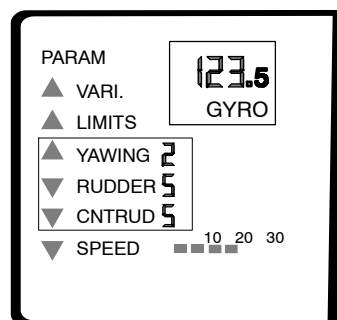
The operational parameters can effectively be varied in any operating mode. If the controller basic adjustment (ship-specific parameters) has been optimized for the ship, often there will be required only weather-conditioned adaptations such as e.g. YAWING (see survey in the Annex – 2 and Chapter 4.13).

Basic Adjustment

After first switching-on of the autopilot, there are the following basic adjustments which – in most cases – mean stable controller characteristics (see section on optimum adjustment by test run, see Chapter 2.3.1):



(Operating mode HEADING CONTROL)

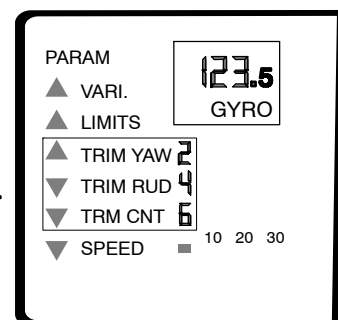


Masked parameters

RUD.LIMIT	20°
RoT °/MIN	30°/min
OFF HEADING	10°



(Operating mode HEADING CONTROL with TRIM FUNCTION; 2nd set of parameters)



Masked parameters

RUD.LIMIT	OFF
RoT °/MIN	30°/min
OFF HEADING	10°

TRIM YAW	2
TRIM RUD	4
TRIM CNT	6

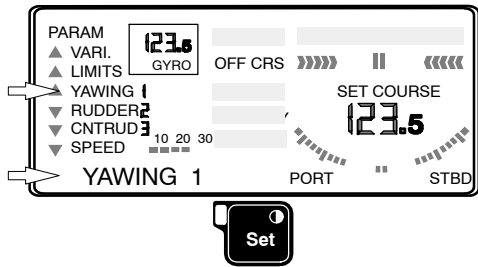
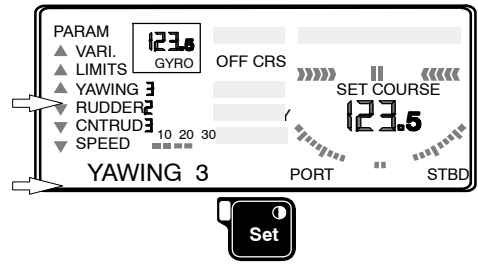
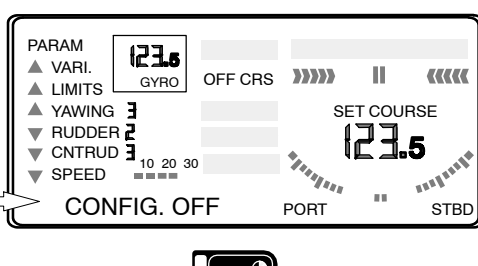
Storing the Individual, Operational Parameter Values

Operational parameter values that are not stored lose their validity after a ship's mains failure or after the ship's mains supply has been disconnected.

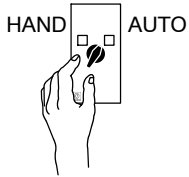
With connecting the ship's mains voltage, the last stored values are indicated on the display and processed in terms of control engineering.

The following representation describes the complete operator action in conjunction with a new parameter value for a **YAWING**.

PILOTSTAR D

	Indications	Remark/Notes
1	Calling up the parameter sequence	
		The last effective parameter value YAWING 1 appears in the text line.
2	Adjusting parameter value 3	
 		The value 3 can be adjusted by actuating the upper key several times. The new value is immediately converted in terms of control engineering. An error message has highest priority and overwrites the current parameter text. Simultaneously, an audible signal is released (see Chapter 2.6).
3	Storing the parameter value 3	
  (on)  (off)  (on)  (on)	 1x press data stored  2x pres data unchanged 	If the new value is intended to remain valid even after disconnection and subsequent reconnection of the ship's mains supply, the following operator actions are required. By actuating the key several times until CONFIG. OFF appears Select CONFIG.ON STORE ? SEL Y/N STORE (Y) → SET STORE (N) → SET

2.3.1



Optimum Adjustment by Test Runs - Operating Mode HEADING CONTROL -

The optimum adjustment can be ascertained by several heading changes of e.g. 10°.

- Set the steering mode selector to position AUTO:
The operating mode *HEADING CONTROL* is active.

If no steering mode selector is available, the key **Auto ON / OFF** is to be actuated.

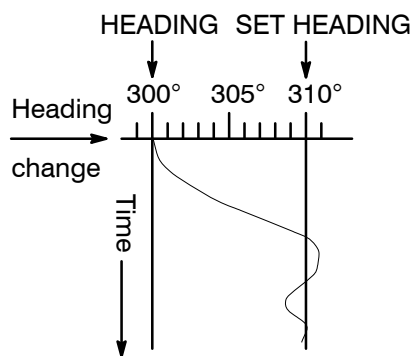
Starting out from the basic adjustment, the following current parameters can be adjusted:

Speed	SPEED (manual or Log)
Rate of turn	RoT °/MIN to 60°/min

For the rudder limitation, high values are to be used in order that a run-in behaviour may be obtained where there is no limitation in the heading control circuit.

- Test run

Observe the LCD displays and the HEADING-to-SET HEADING deviation

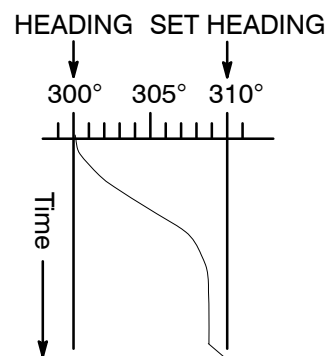


Graph 1

The ship turns into the new heading with overshoots.

Measure:

Increase CNT.RUD. by one step, or decrease RUDDER by one step.
Repeat heading change and observe the control behaviour.

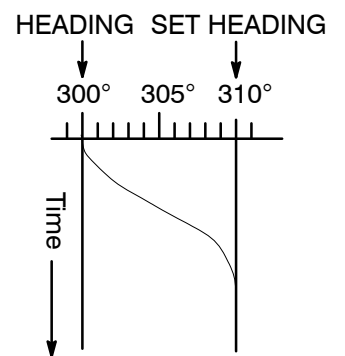


Graph 2

The turns into the new heading too sluggish.

Measure:

Decrease CNT.RUD. by one step, or increase RUDDER by one step.
Repeat heading change and observe the control behaviour.



Graph 3

Shows the optimum parameter adjustment.

Fig. 2-3: Optimization of the Current Parameters

2.3.1.1 Recommended Parameter Values for Various Weather Conditions

- Parameter values for calm sea

YAWING	1 - 2
RUDDER	2 - 5
CNT.RUD.	2 - 5
SPEED	current
RUD.LIMIT	acc. to safety requirement
ROT/MIN	as required
OFF HEADING	as required

Note:

A high value for YAWING results in small rudder angles

- Parameter values for seaway from ahead

YAWING	3 - 5
RUDDER	2 - 5
CNT.RUD.	2 - 5
SPEED	current
RUD.LIMIT	acc. to safety requirement
ROT/MIN	as required
OFF HEADING	as required

- Parameter values for stern sea

YAWING	3 - 5
RUDDER	4 - 7
CNT.RUD.	4 - 7
SPEED	current
RUD.LIMIT	acc. to safety requirement
ROT/MIN	as required
OFF HEADING	as required

- Parameter TRIM Mode

TRIM YAW	as required for special task
TRIM RUD	as required for special task
TRIM CNT.	as required for special task
SPEED	current
RUD.LIMIT	OFF
ROT/MIN	as required
OFF HEADING	as required

NOTE

Generally, attention is to be paid to the fact that the RUD.LIMIT value and the ROT value show an adequate relation to one another. It would be inappropriate to combine a large ROT value with a small RUD.LIMIT value.

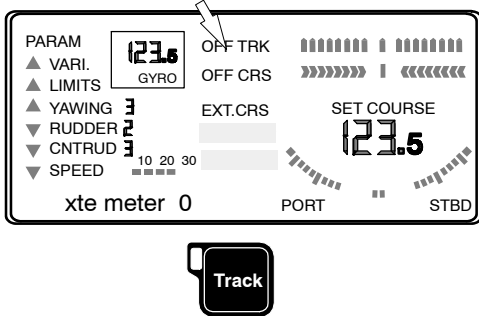
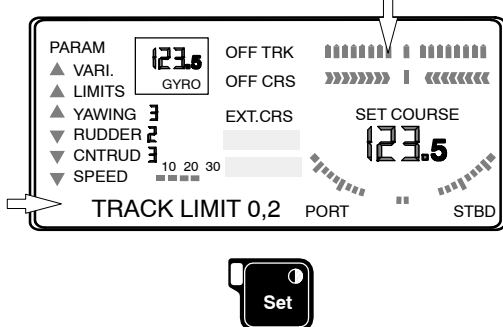
2.3.2

Adjusting the Monitoring Limit for OFF TRACK (OFF TRK)

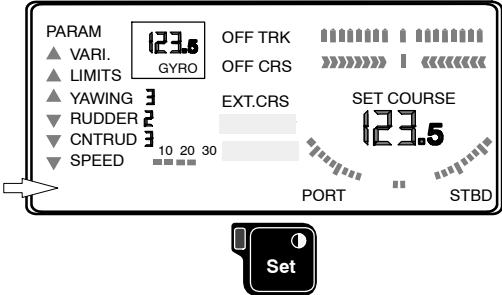
This monitoring limit requires the operating mode **TRACK**.

The monitoring limit describes the left or right distance to the track run though.

Track deviations within the TRACK LIMIT are permissible; if the central dynamic bar graph segment meets with a monitoring limit, an **OFF TRACK** warning message will be released (see Chapter 2.6.1.1).

	Indications	Remark/Notes																
1	The operating mode TRACK is active																	
		The OFF TRK bar graph indication becomes visible.																
2	Calling up the parameter value TRACK LIM ..																	
		The last effective parameter value TRACK LIMIT 0.2 appears in the text line. An error message has highest priority and overwrites the current parameter text. Simultaneously, an audible signal is released (see Chapter 2.6).																
3	Adjusting parameter value																	
 	Possible parameter values are: <table><tr><th>TEXT LINE</th><th>Bar graph indication</th></tr><tr><td>TRACK LIMIT 0.2 nm</td><td>OFF TRK </td></tr><tr><td>TRACK LIMIT 0.3 nm</td><td>OFF TRK </td></tr><tr><td>TRACK LIMIT 0.4 nm</td><td>OFF TRK </td></tr><tr><td>TRACK LIMIT 0.5 nm</td><td>OFF TRK </td></tr><tr><td>TRACK LIMIT 0.6 nm</td><td>OFF TRK </td></tr><tr><td>...</td><td>...</td></tr><tr><td>TRACK LIMIT 1.2 nm</td><td>OFF TRK </td></tr></table> Not represented	TEXT LINE	Bar graph indication	TRACK LIMIT 0.2 nm	OFF TRK 	TRACK LIMIT 0.3 nm	OFF TRK 	TRACK LIMIT 0.4 nm	OFF TRK 	TRACK LIMIT 0.5 nm	OFF TRK 	TRACK LIMIT 0.6 nm	OFF TRK 	...	...	TRACK LIMIT 1.2 nm	OFF TRK 	The intended monitoring range TRACK LIM .. can be adjusted by actuating a key (Storing the parameter value, see Chapter 2.3 of Operating Instructions).
TEXT LINE	Bar graph indication																	
TRACK LIMIT 0.2 nm	OFF TRK 																	
TRACK LIMIT 0.3 nm	OFF TRK 																	
TRACK LIMIT 0.4 nm	OFF TRK 																	
TRACK LIMIT 0.5 nm	OFF TRK 																	
TRACK LIMIT 0.6 nm	OFF TRK 																	
...	...																	
TRACK LIMIT 1.2 nm	OFF TRK 																	



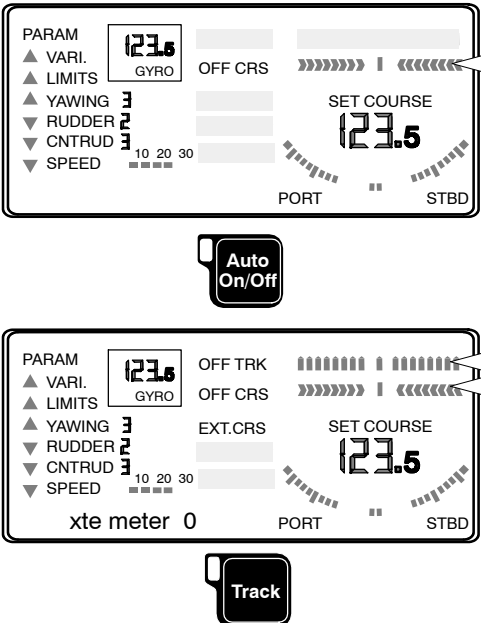
	Indications	Remark/Notes
4 Fading out the text line		
		On actuating the key, the text line is faded out.

2.3.3

Adjusting the Monitoring Limit for OFF HEADING (OFF CRS)

This monitoring limit requires the operating mode **AUTO** (heading control) or the operating mode **TRACK**. The adjusted limit value is the same for the two operating modes, but it describes different indications.

- With the operating mode **AUTO**, the monitoring limit for the set heading/actual heading deviation is adjusted. One segment corresponds to a heading deviation of 2°. In case of a strong heading deviation that reaches the monitoring range, **OFF HEADING** warning is released.
- With the operating mode **TRACK**, the OFF CRS bar graph indication is used for course observation only. No **OFF COURSE** signalling is possible now (see also section 2.2.8).

	Indications	Remark/Notes
1 Calling up an operating mode		
 or 		Select an operating mode, e.g. AUTO . (Heading control) (Track control)

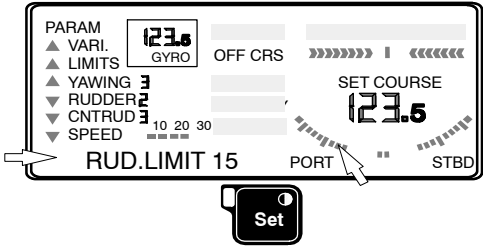
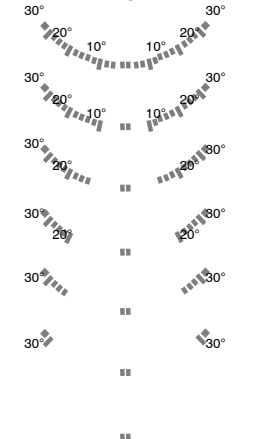
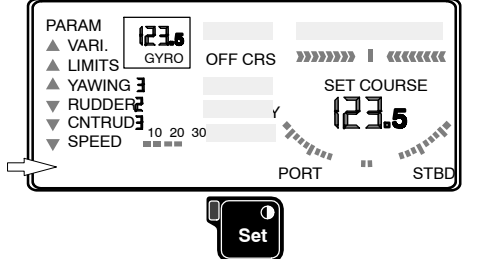
	Indications	Remark/Notes														
2	Calling up the parameter value OFF HEADING															
		The last effective parameter value OFF HEADING 15 appears in the text line. An error message has highest priority and overwrites the current parameter text. Simultaneously, an audible signal is released (see Chapter 2.6).														
3	Adjusting parameter value															
 	Possible parameter values are: <table><thead><tr><th>TEXT LINE</th><th>Bar graph indication</th></tr></thead><tbody><tr><td>OFF HEADING 5° OFF CRS>>>>>>>>> I <<<<<<<<<</td><td></td></tr><tr><td>OFF HEADING 10° OFF CRS>>>>>>>> I <<<<<<<<</td><td></td></tr><tr><td>OFF HEADING 15° OFF CRS>>>>>>>> I <<<<<<<<</td><td></td></tr><tr><td>OFF HEADING 20° OFF CRS>>>>>>>> I <<<<<<<<</td><td></td></tr><tr><td>OFF HEADING 25° OFF CRS>>>>>>>> I <<<<<<<<</td><td></td></tr><tr><td>OFF HEADING 30° OFF CRS>>>>>>>> I <<<<<<<<</td><td></td></tr></tbody></table>	TEXT LINE	Bar graph indication	OFF HEADING 5° OFF CRS>>>>>>>>> I <<<<<<<<<		OFF HEADING 10° OFF CRS>>>>>>>> I <<<<<<<<		OFF HEADING 15° OFF CRS>>>>>>>> I <<<<<<<<		OFF HEADING 20° OFF CRS>>>>>>>> I <<<<<<<<		OFF HEADING 25° OFF CRS>>>>>>>> I <<<<<<<<		OFF HEADING 30° OFF CRS>>>>>>>> I <<<<<<<<		The intended monitoring range OFF HEADING .. can be adjusted by actuating a key (Storing the parameter value, see Chapter 2.3 of Operating Instructions).
TEXT LINE	Bar graph indication															
OFF HEADING 5° OFF CRS>>>>>>>>> I <<<<<<<<<																
OFF HEADING 10° OFF CRS>>>>>>>> I <<<<<<<<																
OFF HEADING 15° OFF CRS>>>>>>>> I <<<<<<<<																
OFF HEADING 20° OFF CRS>>>>>>>> I <<<<<<<<																
OFF HEADING 25° OFF CRS>>>>>>>> I <<<<<<<<																
OFF HEADING 30° OFF CRS>>>>>>>> I <<<<<<<<																
4	Fading out the text line															
		On actuating the key, the text line is faded out.														

2.3.4

Adjusting the Rudder Limitation RUDDER LIMIT (RUD.LIMIT)

The rudder limitation is effective in the operating modes of **TRACK** and **AUTO** and can be adjusted correspondingly.

In the operating modes of **MANUAL STEERING** (dodge function) and **HEADING CONTROL** with **TRIM FUNCTION** (work mode), the rudder limitation is cancelled. With switching back into the operating mode **TRACK** or **AUTO**, the preset rudder limitation is effective again.

	Indications	Remark/Notes
1	Calling up the parameter value RUD.LIMIT ..	
		The last effective parameter value RUD.LIMIT 15 appears in the text line. An error message has highest priority and overwrites the current parameter text. Simultaneously, an audible signal is released (see Chapter. 2.6).
2	Adjusting parameter value	
 	Possible parameter values are: TEXT LINE RUD.LIMIT 5° RUD.LIMIT 10° RUD.LIMIT 15° RUD.LIMIT 20° RUD.LIMIT 25° RUD.LIMIT 30° RUD.LIMIT 35° Rudder angle indicator 	The intended monitoring range RUD.LIMIT.. can be adjusted by actuating a key (Storing the parameter value, see Chapter 2.3 of Operating Instructions).
3	Fading out the text line	
		On actuating the key, the text line is faded out.

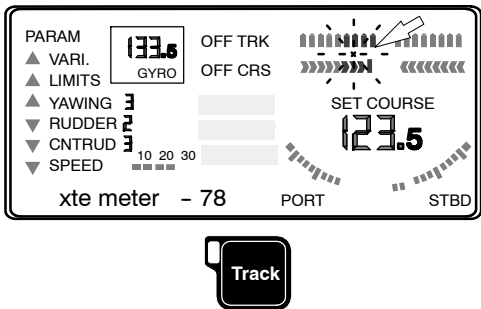
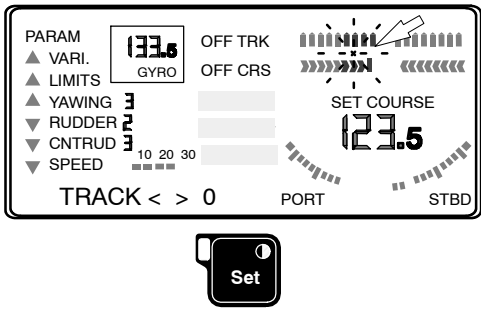
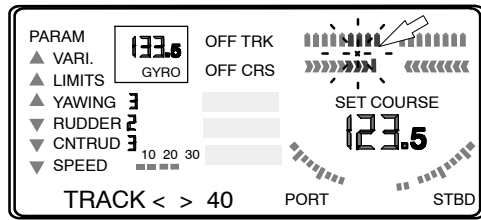
2.3.5

Optimizing the Control Characteristics of the Track Controller, TRACK < >

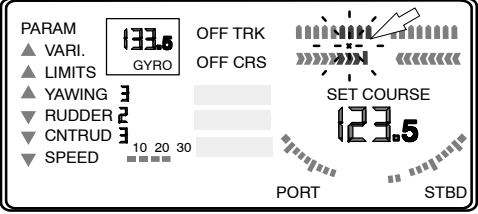
The parameter adjustment of the track controller is preset as a standard for normal wind or current conditions.

If, however, a heavy drift occurs for instance, a considerable track error may be the result.

On re-adjusting the parameter TRACK < >, the gain of the track controller can be augmented or reduced, by this, the reaction and, therefore, the track course accuracy can considerably be improved.

	Indications	Remark/Notes
1	Operating mode TRACK is active 	After pressing the track key the current distance from track is indicated for approx. 3s.
	Calling up the parameter value TRACK < > 	The preset parameter value is "0" (default setting).
 (-280...280)  (-280...280)	Adjusting the parameter value, e.g. 41 	A positive value (e.g. 40) increases the gain of the track controller. The course trim angle becomes greater, the track course behaviour will be improved. Track<> can be adjusted in steps of 20° from -280 to 0 to 280.

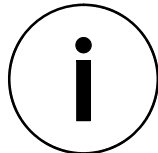
PILOTSTAR D

	Indications	Remark/Notes
4	Fading out the text line	
	 	By actuating the key, the text line will be faded out

2.3.6

Synchronization of the Autopilot for a Gyro Compass with Step Transmission

In case of a gyro compass system whose type of signal transmission corresponds to an *ACO Step STANDARD 14* or *1/6° Step* signal (see Annex - 3), the PILOTSTAR D must be synchronized new after any putting into operation or after a short-time voltage failure.

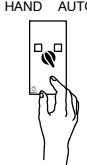
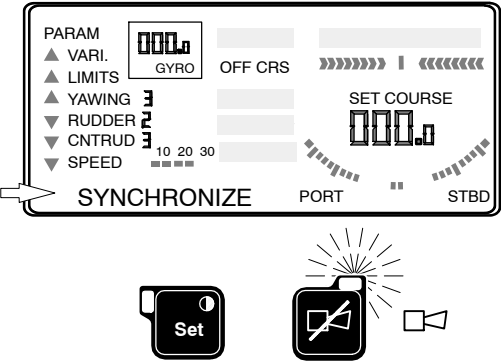
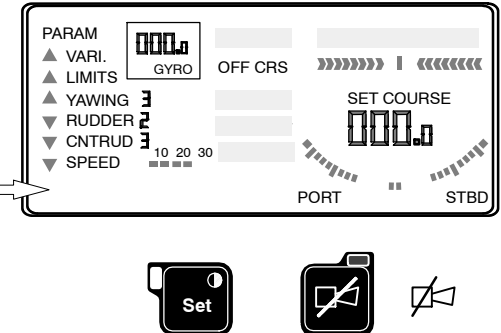


Before synchronization:

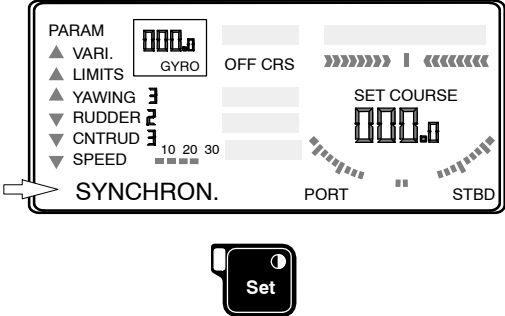
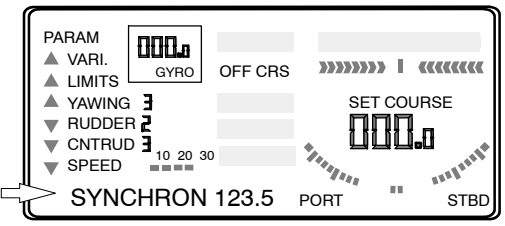
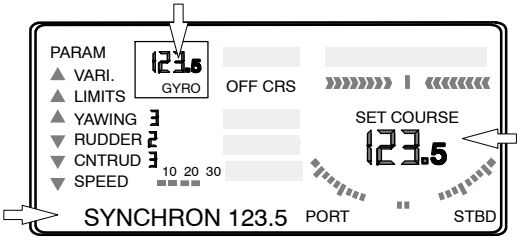
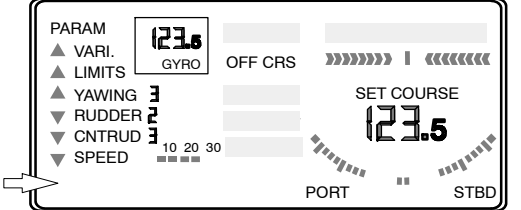
Select to **MANUAL CONTROL** (s. Chapter 2.2.9) or

Set steering mode selector to position **HAND**.

Putting into operation means here that the PILOTSTAR D had been separated from the ship's mains. With reconnecting the PILOTSTAR D to the ship's mains, the following indication adjusts itself.

	Indications	Remark/Notes
1	Switching on the PILOTSTAR D	
 or 		After putting into operation, an audible signal sounds, the LED of the symbol key is flashing.
2	Acknowledging the system message	
		On actuating the key, the audible signal ceases, the LED goes out, the text line is faded out.

PILOTSTAR D

	Indications	Remark/Notes
3	Calling up the parameter value SYNCHRON	
		On actuating the key several times, the parameter SYNCHRON.... adjusts itself in the text line.
4	Adjusting the synchronization value	
 		The synchronization value can be read off via the gyro compass, e.g.. 123.5°. Input of values is via the keys. A continuously actuated key permits automatic run-up of the numerical indication within the text line.
5	Accepting the synchronization value	
		On actuating the key, the compass value is accepted and represented in the heading indication and in the set heading indication. The synchronization procedure is terminated; an optional operating mode can be selected.
6	Fading out the text line	
		On actuating the key, the text line is faded out.

2.4

Ship-specific Parameters (CONFIG. on)

As a matter of principle, the autopilot is delivered with preset parameter values (see Annex -1, column DEFAULT).

Adjustment of the ship-specific parameters is required only in conjunction with first installation or in case of system extension (see Chapter 4.10 and 4.13).

By inputting new values, the DEFAULT values are overwritten. The new parameter values are stored when the CONFIGURATION mode (CONFIG: OFF) is left and the STORE (Y) SET command is executed.

All ship-specific and operational parameters are permanently filed in an EEPROM and will be available also after a voltage failure.

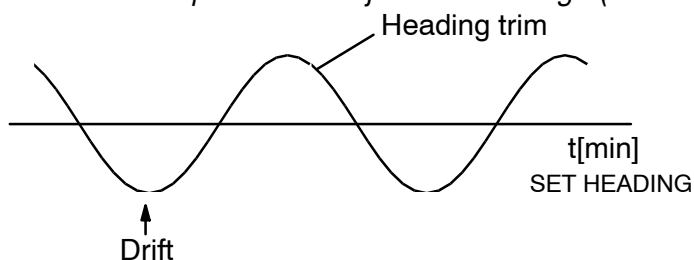
2.4.1 Adjusting the Ship-specific Parameters

As an example, a new XTE TRIM parameter value is to be adjusted here, in the meaning of: The integration time of cross track error (fast and slow).

Short information on the XTE TRIM parameter and on the situation when a new value should be adjusted.

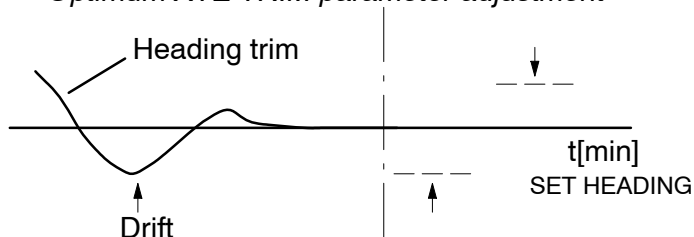
The XTE TRIM parameter (cross track error trim) is effective during track control only. By means of this parameter, permanent oscillations about the tracks course can be compensated. In most cases, this effect occurs in conjunction with a constant drift (see the following illustrations).

XTE TRIM parameter adjustment too high (overcompensation)



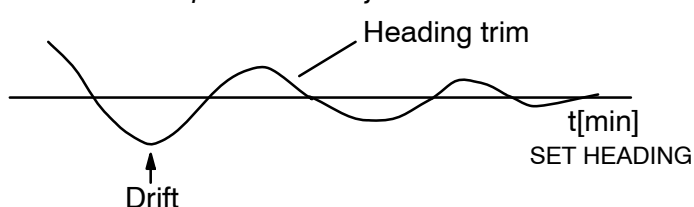
The ship performs a continuous, changing motion about the track course. The effect of drift is levelled unsatisfactorily. The track controller response is too fast.

Optimum XTE TRIM parameter adjustment

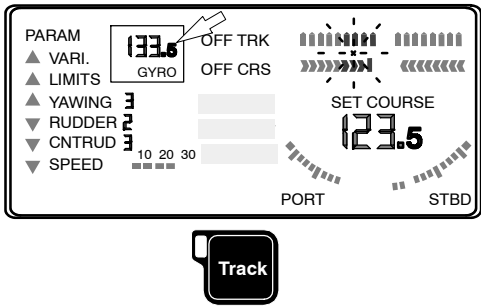
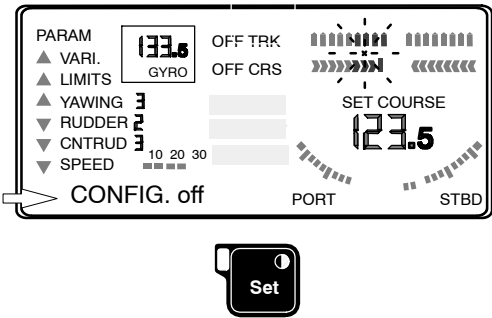
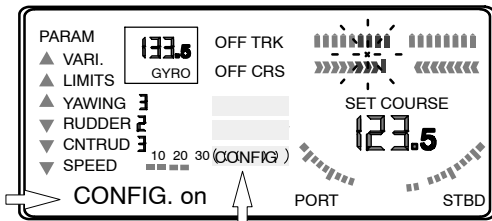
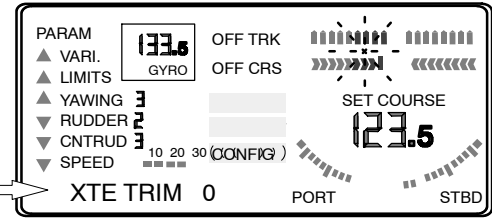


Good error compensation
The ship reacts upon the drift in an optimum way. The heading trim becomes stable dependent on the drift direction. A too high track error can be corrected via the parameter TRACK < > (see Chapter 2.3.5).

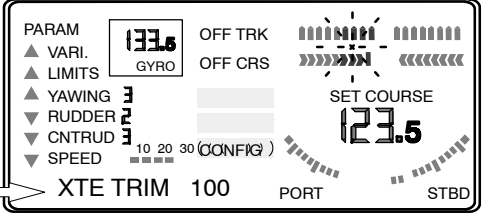
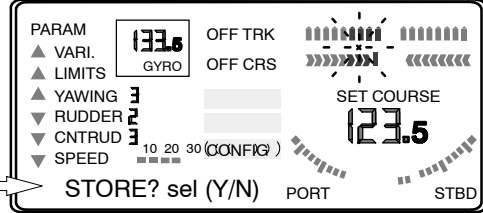
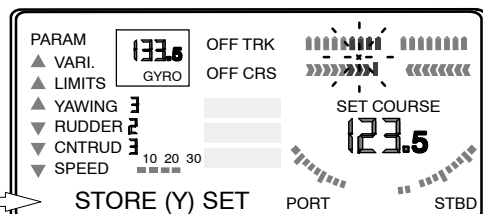
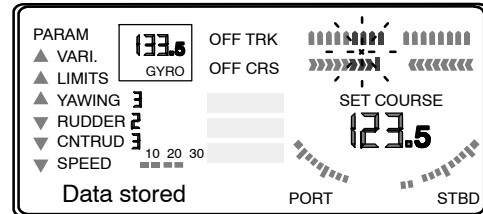
XTE TRIM parameter adjustment too low



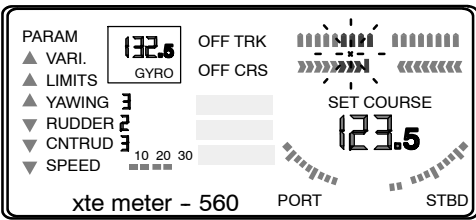
Less error compensation
The control process will be terminated only when a correspondingly long time has passed. Track controller reaction sluggish.

	Indication	Remark/Notes
1	Operating mode TRACK is active, the ship oscillates, e.g. about the track course	
		The actual heading continuously changes by e.g. $\pm 15^\circ$. The default value of the XTE parameter must be corrected. In this situation, a higher XTE TRIM value, e.g. 100, is recommended.
2	Calling up the parameter sequence	
		By actuating the key several times, the parameter CONFIG.off appears in the text line.
3	Opening the parameter sequence	
 (on)		The status indication is flashing. By actuation of the key, the parameter sequence is opened
4	Calling up the parameter	
		The last parameter adjustment, e.g. 0, is indicated (corresponding to default setting)

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	Indications	Remark/Notes
5 Adjusting the parameter value 100		
 		The desired value can be adjusted by repeated actuation (the value changes by jumps of tens).
6 Leaving the parameter sequence		
		
7 Store parameter values, YES or NO		
 1x  2x		On pressing the key once, the new parameter are stored (Y)es. Alternatively: On pressing the key twice, the old parameters remain valid (N)o.
8 Storing parameter values		
	 	By selecting STORE(N) the message 'Data unchanged' appears.



	Indications	Remark/Notes
9 Call up cross track error		
		The current distance from the track is indicated for approx. 3s. The optimum XTE TRIM parameter value is to be ascertained by observing the actual cross track error.

2.5 Change-over of between Main and Secondary Operator Units / Tiller

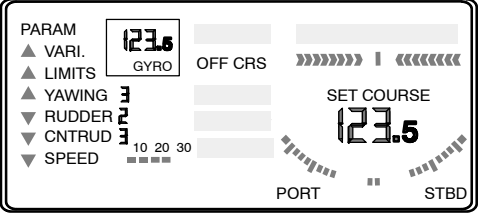
Change-over of between the main and secondary operator units or the tillers is always performed via the intended steering station.

2.5.1 Change-over between a Main Operator Unit and a Secondary Operator Unit

The main and secondary operator units are of the same type and – except for the access authorization to the ship-specific parameters – equal with regard to operator guidance. The ship-specific parameters can be varied or adjusted via the main operator unit only (CONFIG on/off).

For this steering mode, the steering mode selector must be set to position **AUTO**.

A "Take-over System" permits change-over between the operator units.

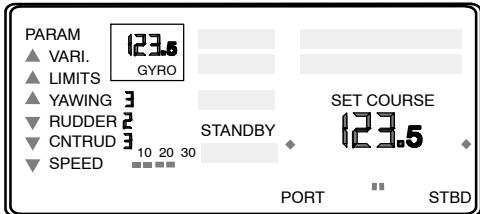
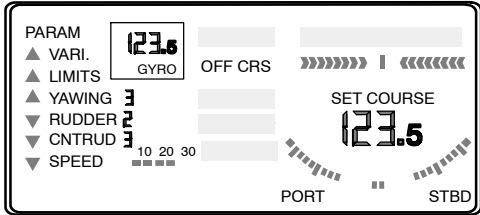
	Indications	Remark/Notes
1 Changing over to a secondary operator unit		
  3x	Secondary operator unit 	With actuating the key on the secondary operator unit, the following state adjusts itself: - The secondary operator unit is active. - The current operating mode is accepted (AUTO, TRACK, MAN, TRIM). - All other operator units or tillers are passive, the status indicator STANDBY is enabled. System messages are indicated without audible signalling. - Possible system messages are indicated on the secondary operator unit with a signalling.

2.5.2

Change-over to Tiller Control (FU / NFU)

For this steering mode, the steering mode selector must be switched to position **AUTO**.

The tillers are equipped with a *Take-over Function* with permits immediate intervention in the automated steering control system.

	Indications	Remark/Notes
1 	Changing over to tiller control  	With actuating the key on the tiller, the following state adjusts itself: - The tiller is active, the current heading becomes the set heading - All other operator units or tillers are passive; the status indicator STANDBY is enabled. - Possible system messages are indicated in the text line, but not signalized. - The rudder angle indicator indicates the current rudder position.
2 	Switching back to the PILOTSTAR D  	With actuating the key on the tiller, the following state adjusts itself: - The tiller control is de-activated. - The main operator unit is switched from the STANDBY mode into the operating mode AUTO. - All the other operator units remain in the STANDBY mode. The LED of the key is alight.

2.6 Signification of the System Messages in the Autopilot

As a matter of principle, system messages are indicated via the text line as plain text information. Dependent on the significance of the message, a text in the text line is overwritten by the system message.

The plain text info is intensified by an audible signal and by the flashing LED of the symbol key.

System messages can be subdivided into 2 categories:

- System messages during operation - **Warnings and Notes** -
- System messages that - during operation - signalize a **disturbed operation** of the autopilot system.

2.6.1 Warnings and Notes

Within an operating mode, all steering-typical autopilot functions are currently indicated on the display and monitored.

In case the monitoring limits are exceeded, a warning message is faded into the text line and an audible signal is released.

In conjunction with a connected active tiller, the corresponding steering station is indicated in the text line.

2.6.1.1

Signification of Possible Warnings in the Text Line

Warnings	Signification	Possible Measures	Measures on the Operator Unit/Periphery
OFF HEADING	The heading is outside the monitoring limits. The heading deviation increases. PILOTSTAR D or steering output is defective.	Check the operational parameters; adapt, if required. The monitoring limits have been selected too narrow; extend, if required. Change over to operating mode "Manual Control". Set steering mode selector to position "Hand".	 see Chap. 2.3  OFF HEADING or RUD.LIM see Chap. 2.3  see Chap. 2.2.9 or HAND  AUTO
OFF TRACK	The actual position is outside the track monitoring limits. PILOTSTAR D or steering output is defective.	Check the operational parameters; ADAPT; IF REQUIRED: Change over to the operating mode of heading control. Change over to the operating mode of manual control. Set steering mode selector to position "Hand".	 see Chap. 2.3   see Chap. 2.2.6  see Chap. 2.2.9 or HAND  AUTO
LOW SPEED (if LOG-Sensor is existing)	If the speed is slower than 3Kn. The steering quality from Autopilot is going bad.	Give more speed if the situation allows. Set steering mode selector to position "Hand".	 see Chap. 2.2.9 or HAND  AUTO

Warnings	Signification	Possible Measures	Measures on the Operator Unit/Periphery
HEADING MON	The heading from the magnetic compass is outside the monitoring limits. GYRO defective	Check the magnetic heading correction. Check the operational parameters: adapt, if required. Try to correct the magnetic heading with VARIATION setting. Change over heading sensor (magnetic or fluxgate compass) The monitoring limits have been selected too narrow; extend, if required. Change over to operating mode "Manual Control". Set steering mode selector to position "Hand".	  see Chap. 2.3 OFF HEADING or RUD.LIM see Chap. 2.3  see Chap. 2.2.9 or HAND  AUTO

2.6.1.2

Signification of Possible Notes within the Text Line

Note	Signification	Measures	Measures on the Operator Unit/Periphery
NEW TRACK ...	The navigation receiver transmits the next track section data to the autopilot.	Acknowledge the plain text message.	 see Chap. 2.2.8.2
TILLER ...	The symbole key on the tiller has been actuated. The autopilot operator unit is automatically switched to operating mode STANDBY		 see Chap. 2.5.2

2.6.2

Disturbed Operation

"Disturbed Operation" means that under these conditions a unique operating state of the autopilot is no longer possible.

Any fault message is indicated as plain text via the text line; simultaneously, audible alarm is given.

A fault message – in addition to the plain text information – includes the ending **FAILure**.



Fault messages are treated with highest priority.

The audible alarm can be acknowledged, the fault message remains applied.

The LED of the symbol key is alight for the duration of the captured disturbance.

If a second disturbance is recognized, this will be indicated, the first disturbance indication being set back in hierarchy.

If the second source of trouble can be eliminated, the first fault message appears in the text line again.

After the disturbance has successfully been eliminated, the audible signalling is repeated, thus signaling the trouble-free operating state.

On actuating the symbol key, the signal ceases, the fault message is cancelled.

2.6.2.1

Disturbed Operation in connection with a Central Alarm System (Option)

The acknowledgement of an alarm in connection with a central, external alarm system can be realized as follows:

In principle, an audible alarm is simultaneously indicated at the autopilot and the central alarm system. The audible alarm can be acknowledged directly at the autopilot or via the external alarm system.

The audible alarm is simultaneously acknowledged in both cases.

Configuration in CONFIG Mode: RELAY Alarm

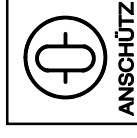
2.6.3

Possible Fault Messages and Measures to be taken

The following table shows all possible fault messages, the causes involved and measures for eliminating the disturbance.

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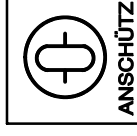
PILOTSTAR D



Autopilot

No.	Indication	Signification	Possible Cause	Effects on Operation	Measures
1	AUTO FAIL	Internal disturbance in the PILOTSTAR D system. With a Central Alarm System the relay output 'AUTO FAIL' is summarised in acoustical and optical alarms.	- Program trouble - CPU PCB disturbed or defective see Central Alarm System	System is no longer ready for operation. see Central Alarm System	- Switch off/on the system via the steering mode selector - Set the steering mode selector to position HAND - Check the LED display on the CPU PCB (see Chapter 3.4) - Exchange the CPU PCB (see Chapter 3.3.3) - see Central Alarm System section 1.6.3
2	PANEL FAIL	Operator unit not operating faultlessly.	- Connecting cable broken - Supply voltage failure operator unit - Operator unit defective	System is no longer ready for operation.	- Set the steering mode selector to position HAND - Check the LED display on the CPU PCB (see Chapter 3.4) - Check connecting cable - Check supply voltage - Exchange operator unit
3	GYRO FAIL	Gyro data transmission is not plausible. Gyro in settling mode Gyro in heating mode Gyro 'Follow Up' disturbed Gyro heading failure	- Connecting cable broken, GYRO defective (in case of step system) With a short –time ship's mains failure, the synchronization value gets lost	System readiness for operation is conditional. The last heading is automatically stored, the set heading is caused to follow up. Autopilot MAN Mode possible, Autopilot AUTO Mode not possible	- Select the magnetic or fluxgate compass via the operator unit - Check connecting cable - Check GYRO/Operational condition - Check synchronization; adjust, if required (see Chapter 2.3.5)
4	MAGNET FAIL	Magnetic/fluxgate data transmission is not plausible.	- Connecting cable broken, magnetic/fluxgate compass defective - Sonde operation is disturbed - Coursebus (Magnet information not available)	System readiness for operation is conditional. The last heading is automatically stored, the set heading is caused to follow up.	- Set the steering mode selector to position HAND - Select the gyro compass via the operator unit - Check the connecting cable - Check the magnetic/fluxgate compass

PILOTSTAR D

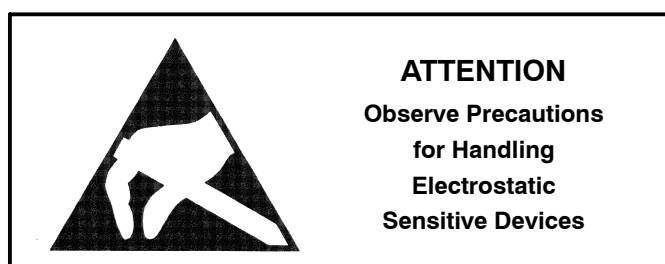


Autopilot

No.	Indication	Signification	Possible Cause	Effects on Operation	Measures
5	STEERING FAIL	Disturbance in steering control circuit	- Steering gear disturbed or defective - Feedback unit disturbed or defective - The preset rudder positioning speed has not been adjusted correctly - FU control defective, or Rud Fail limits too narrow	System is no longer ready for operation.	- Set steering mode selector to position HAND - Check parameter value for RUD.SPEED adjust, if required (see Chapter 2.3) - Extend RUD FAIL limits
6	NAVDATA FAIL	Disturbance of track course data transmission	- Connecting cable defective - Navigation receiver or set course transmission system defective	Operating mode TRACK is no longer possible.	Adjust operating mode AUTO or MAN
7	Nav Data invalid	Data transmission from position receiver	Poor reception	Operating mode TRACK is conditionally ready for operation	Adjust operating mode AUTO or MAN
8	no Connection	Internal disturbance in the PILOTSTAR D system	- Program trouble - CPU PCB disturbed or defective - Connecting cable to operator unit interrupted	System is no longer ready for operation.	- Re-initialize the device via hardware RESET switch on the CPU PCB (see Chapter 3.3.2) - Exchange the CPU PCB (see Chapter 3.4) - Check connecting cable

3 Care, Maintenance and Shipboard Repair

3.1 SAFETY NOTES



CAUTION

Handling of Electrostatic-sensitive Semiconductor Devices

Certain semiconductor devices used in the equipment are liable to damage due to static voltage. Observe the following precautions when handling these parts or sub-units of the system components which, because of the now open inputs of the semiconductor devices, are endangered by static charge.

- 1) Persons removing sub-units from an equipment using these devices must be earthed by a wrist strap and a resistor at the point provided on the equipment.
- 2) Soldering irons used during the repair operations must be low voltage types with earthed tips and isolated from the mains voltage by a double insulated transformer.
- 3) Outer clothing worn must be unable to generate static charges.
- 4) Printed Circuit Boards (PCBs) fitted with these devices must be stored and transported in anti-static bags.
PCBs are to be laid down on non-conducting surfaces free from static charge only!

3.1.1 Ship's Safety

According to the GERMAN LLOYD and to other regulations, the autopilot has been classified as a **SECONDARY STEERING SYSTEM**, i.e. without redundant installation nor internal redundancy. A MAIN STEERING SYSTEM, however, for example manual control, must be installed twice and without reactive effects.

In the course of this description, a system component designated as a main and secondary operator unit is often referred to in the text.

The significance of these operator units and the autopilot function connected therewith is always to be considered as a **SECONDARY STEERING SYSTEM** within the complete system!

Our devices are manufactured and tested in accordance with an international quality assurance system (ISO 9001). Nevertheless, errors cannot fully be excluded.

Therefore, the national and international regulations include the following requirement: The autopilot is equipped with an extensive monitoring logic, by means of which errors or failures within the autopilot system or connected sensors can be recognized. Alarm signalling is audible or visual via the operator unit.

3.1.2 Checks to be made before any Putting into Operation

In order to ensure correct functioning of the autopilot, faultless operation of the following systems and devices is required:

- Power supply
 - for the equipment concerned
 - 10 ... 36V DC for the autopilot
- Steering gear and steering control system
- Sensors and appertaining transmission equipment
 - Gyro compass
 - Magnetic compass / fluxgate compass
 - Log
 - Navigation receiver



3.2 Care and Maintenance

3.2.1 Care

The PILOTSTAR D system requires no care.

3.2.2 Maintenance

The PILOTSTAR D system is maintenance-free.

3.3 Shipboard Repair

See Fig. 3-2

3.3.1 Exchanging the Fuse in the Connection Unit

The fuse (T 2A) is located on the junction PCB. For exchanging the fuse, the hood of the connection unit is to be removed (see Junction PCB 102 D 863 HP010).

NOTE



On exchanging the fuse, take the location of the fuse into consideration.

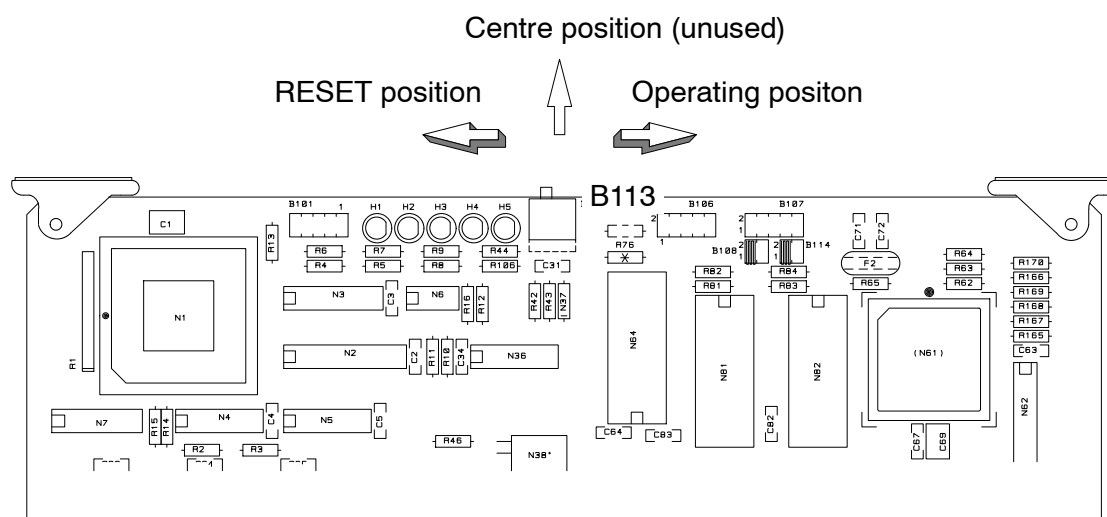
- For a ship's mains supply of 32V DC, the fuse base F1 is prescribed.
- For a ship's mains supply of 12 / 24V DC, the fuse base F2 is prescribed.

3.3.2 Hardware RESET, Warm Start (Service Switch B113)

The service switch is located on the front side of the CPU PCB.

After the hood has been removed, the service switch can be actuated.

Set the switch momentarily from the operating position to position RESET and then back.



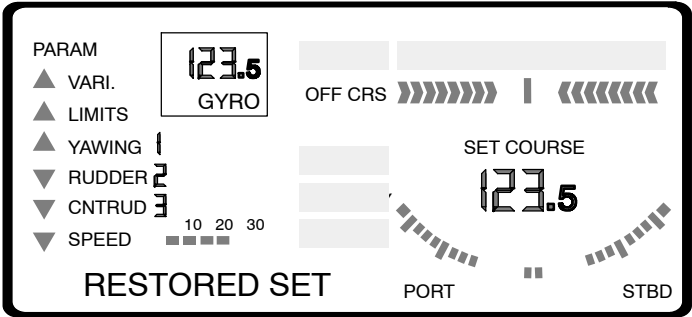


The PILOTSTAR D is initialized with the ship-specific parameter values.

NOTE

For a gyro compass with STEP transmission, the synchronization gets lost in case of a WARM START (see Chapter 2.3.6).

The LCD display indication is as follows:



3.3.3

Exchanging a PCB

Before the PCB is exchanged, the hood and the cover plate are to be removed (see Fig. 3-2).

The PCBs are to be removed and to be inserted by means of their PCB drawers.

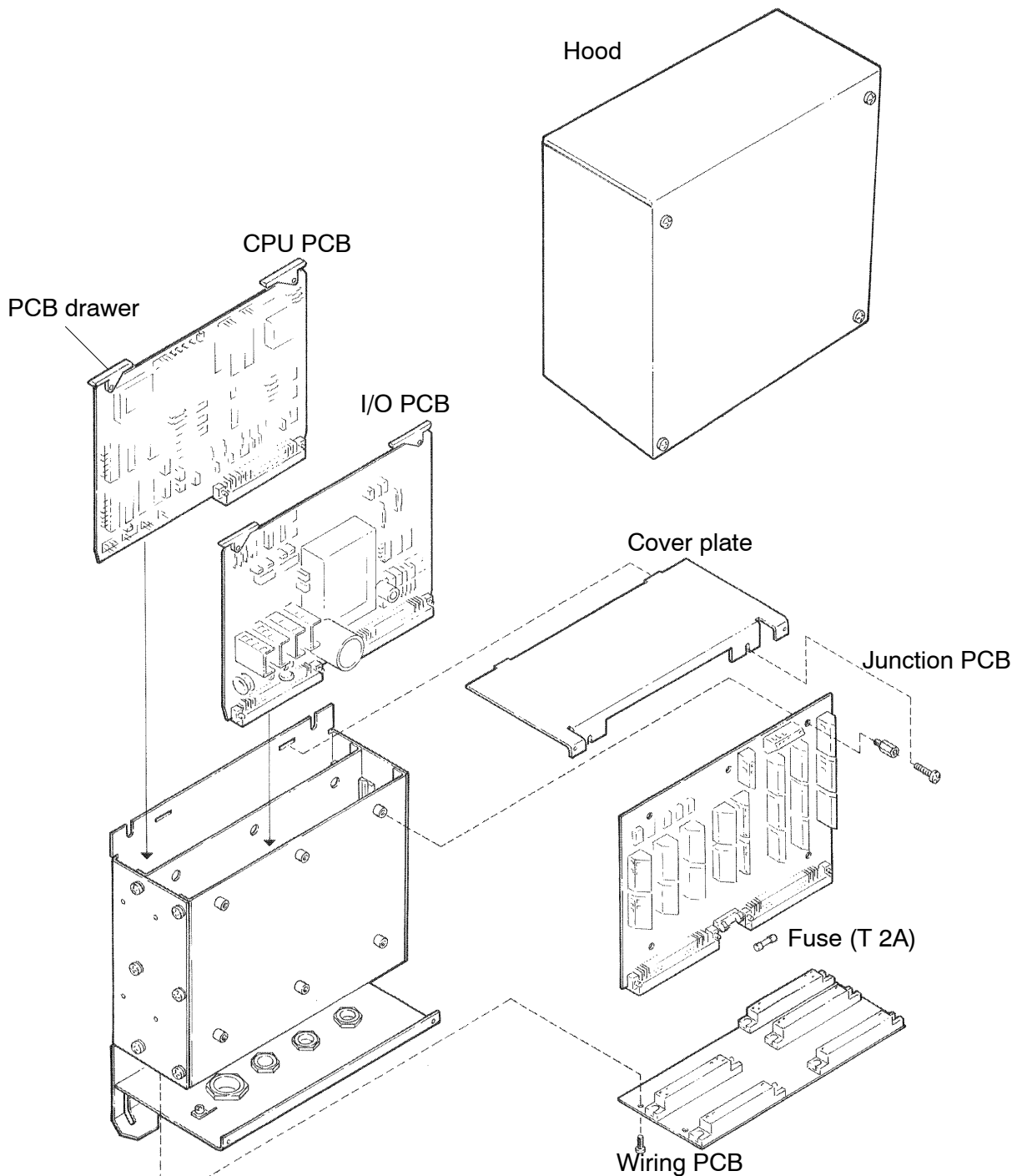


Fig. 3-2: Connection Unit, opened

3.4 LED Displays on the CPU PCB

The LEDs are located on the front side of the CPU PCB.

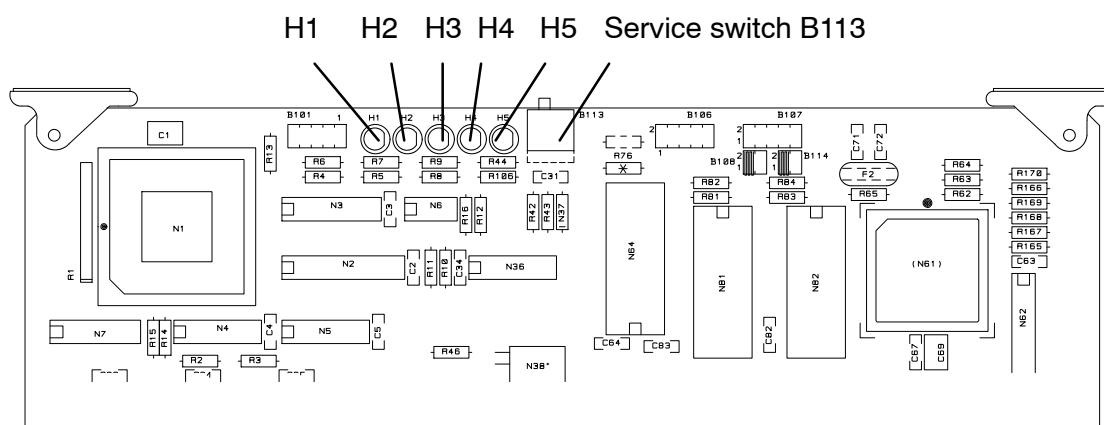
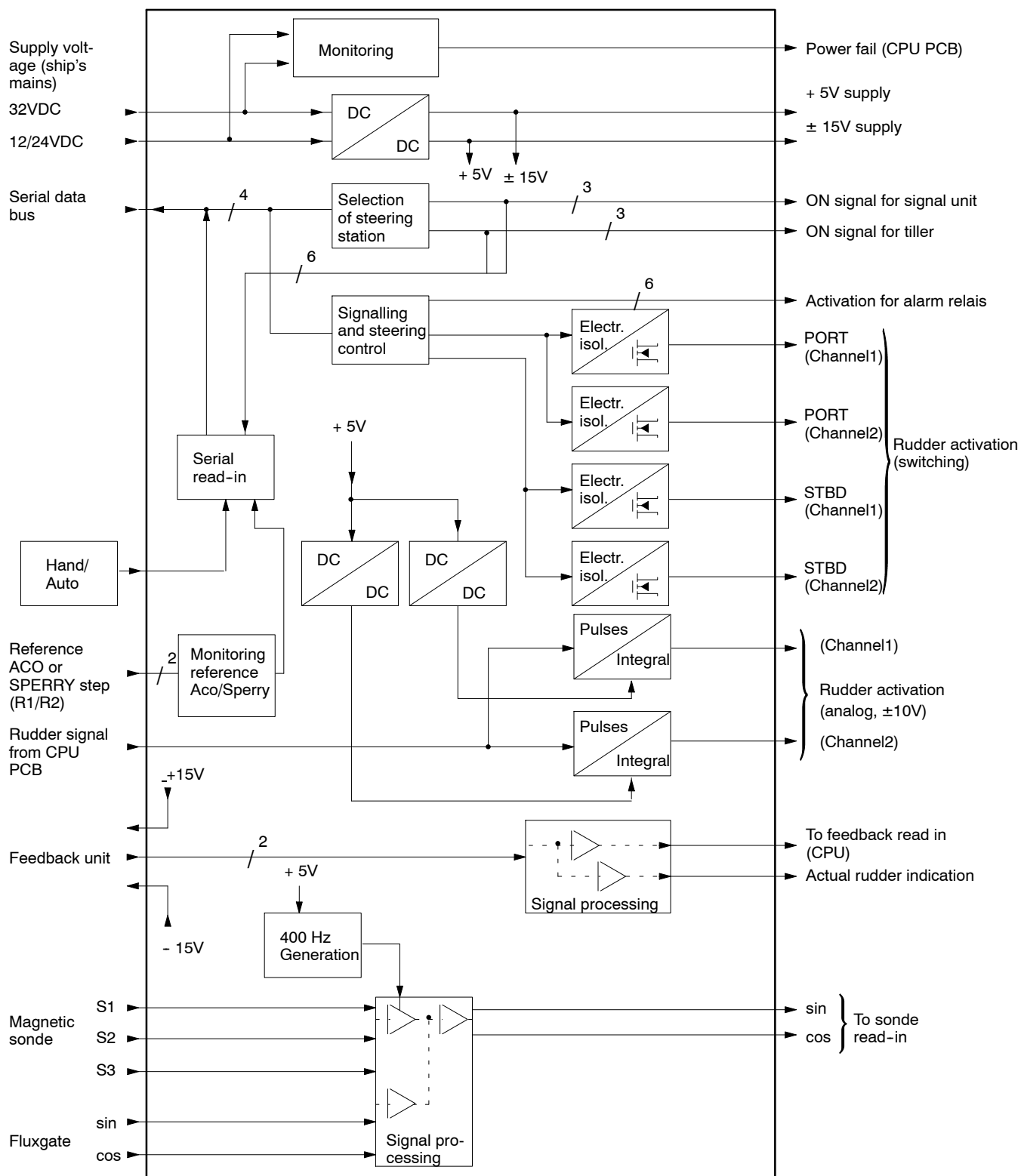


Fig. 3-3: LEDs on the CPU PCB

LED	Colour	Indication	Cause	Measure
H1	green	alight	Warm start has been activated	Actuate the service switch B113 on the CPU PCB
H2	red	alight	Internal error, CPU is at HALT	Actuate the service switch B113 on the CPU PCB
H3	green	alight	Supply voltage is o.k.	
H4	yellow	flashing	Indicates the active serial data transmission between the operator unit and the CPU PCB	
H5	green	flashing	Indicates the active pulse log transmission	

3.5 Repair

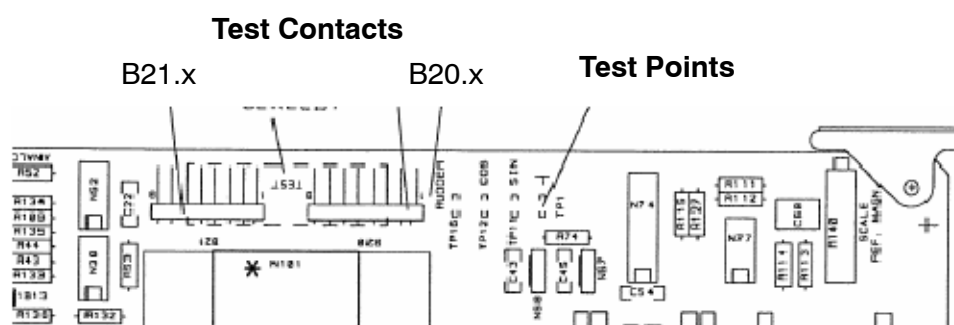
3.5.1 Block Diagram of the I/O PCB



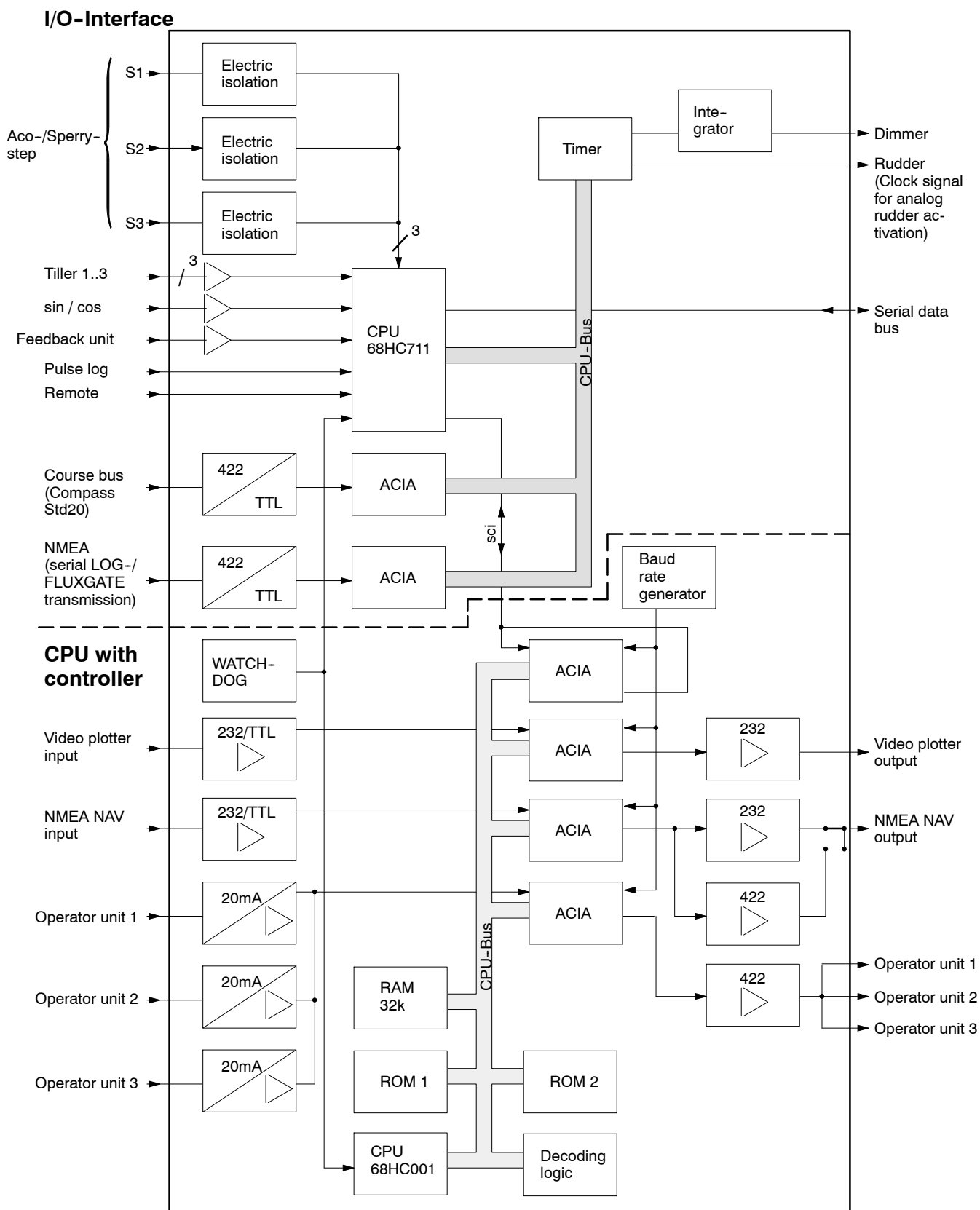
3.5.1.1

Test Points of the I/O PCB

Test Points (TP) Test Contacts B20.x and B21.x	Signification	Remark
TP 1	Signal ground (GND, AGND)	
B21.5	+ 15V ₆	} Electrically isolated voltage supply for analog rudder output 1
B21.2	GND ₆	
B21.6	- 15V ₆	
B21.7	+ 15V ₇	} Electrically isolated voltage supply for analog rudder output 2
B21.4	GND ₇	
B21.3	- 15V ₇	
B20.4	sin signal of magnetic sonde	} PCB adjustment performed at the works (U sin = U cos with $\alpha 45^\circ$)
B20.6	cos signal of magnetic sonde	
B20.3	800 Hz TTL signal to TP 1	
TP 11	sin signal of magnetic sonde/flux-gate	} PCB adjustment performed at the works (U sin = U cos with $\alpha 45^\circ$)
TP 12	cos signal of magnetic sonde	
B20.5	+ 15V	} Common ground to TP1
B20.8	- 15V	
TP 16	Actual rudder signal to TP 1	

**Fig. 3-4** Measuring points on the I/O PCB

3.5.2 Block Diagram of the CPU PCB



4 Installation, Putting into Operation

4.1 SAFETY NOTES

ATTENTION	In opened devices or desks, voltages representing a risk of electric shock are applied.
	- SAFETY INSTRUCTION - As a matter of principle, the system is to be made dead when installation work is performed on the equipment as well as during disassembly/assembly of components or during alteration of the circuitry.

4.1.1 Checks to be made before any Putting into Operation

In order to ensure correct functioning of the autopilot, faultless operation of the following systems and devices is required:

- Power supply
 - for the equipment concerned
 - 10 ... 36V DC for the autopilot
- Steering gear and steering control system
- Sensors and appertaining transmission equipment
 - Gyro compass
 - Magnetic compass / fluxgate compass
 - Log
 - Navigation receiver

4.2 Stock Taking and Inspection of Delivery

Remove the equipment parts from the cardboard boxes.

Check all equipment parts for visual deficiencies and transport damages.

Place all equipment parts on a safe support.

4.3 Installation Planning and Instruction

4.3.1 Operator Unit (Dimensional Drawing 102D864.HP005)

Requirements to be met by the mounting site:

The device has to be readily visible and be placed such as to ensure convenient handling.

For the flush mounting, refer to the Dimensional Drawing 102D864.HP005 (recess and drilling scheme).

NOTE



Prior to starting work, ensure that below the selected point of recess there is sufficient space for the sawing work required.

4.3.2 Connection Unit (Dimensional Drawing 102E863.HP005)

Requirements to be met by the mounting site:

The connection unit should be located within a radius of approx. 2m with regard to the operator unit. The clearance above the connection unit specified in the dimensional drawing must absolutely be ensured.

4.3.3 Feedback Unit (Dimensional Drawing 101C529 HP005)

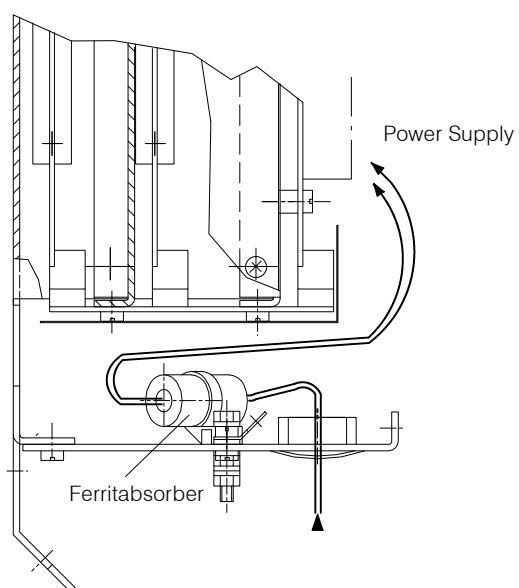
Requirements to be met by the mounting site:

1. In case linkage transmission is selected, it is to be ensured that this cannot be blocked by loose objects!
All cables lying within this area must be fixed.
2. If toothed-belt transmission is selected, this must be correctly pre-stressed as indicated in the dimensional drawing.
All cables lying in the vicinity must be fixed.

4.4**Cabling of the Equipment**

The cabling of the equipment is ship-specific, refer to the enclosed Connection Diagram AP02 C S01 HP051.

The -POWER SUPPLY- ship's cable must be passed through the ferrite absorber before wiring is carried out; refer to the following diagram.

**NOTES**

4.5 Ship-specific Parameters (CONFIG. on)

As a matter of principle, the autopilot is delivered with preset parameter values (see Annex – 4, column DEFAULT).

As a principle, the adjustment of the ship-specific parameters is only required on the occasion of first installation or in case of system extension.

By entering new values, the DEFAULT values will be overwritten.

After installation or in case of system extension, the ship-specific parameters must adequately be adapted.

On leaving the CONFIGURATION mode (CONFIG. OFF), the new parameter values will be stored (see sections 2.4.1 and 4.5.1).

All ship-specific and operationally-conditioned parameters are permanently filed in an EEPROM and will be available again even after a voltage failure.

- **Cold Start** (COLD STRT, Kap. 4.6)

By the cold start, all parameter values that have been entered by the user will be cancelled. The AUTOPILOT assumes its initial state (first putting into operation).

The "Default" parameter values are now effective with regard to control engineering.

The ship-specific parameter values can now be entered again.

4.5.1

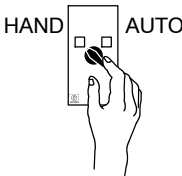
Adjusting the Ship-specific Parameters

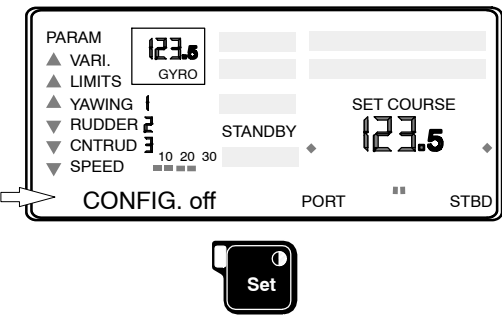
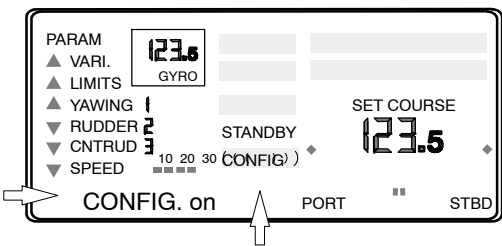
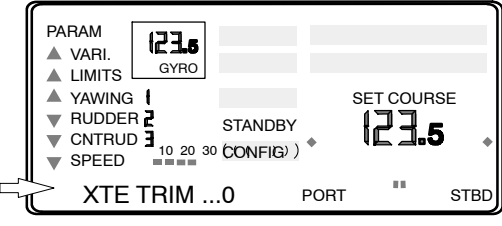
NOTE



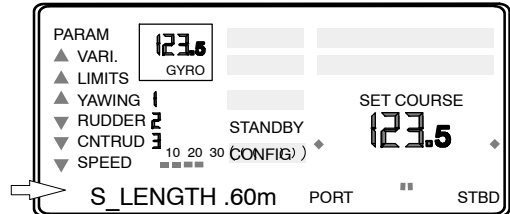
Prior to adjustment, the autopilot is to be switched into the **STANDBY** mode.

Set the steering mode selector to **MANUAL CONTROL**.

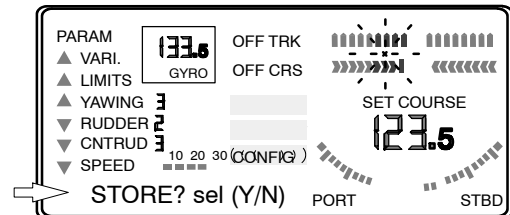
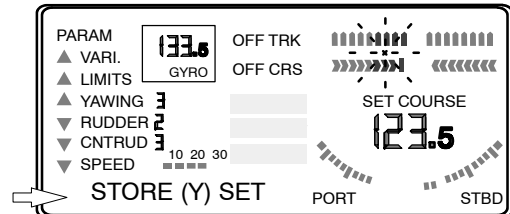
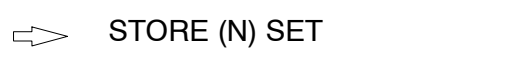


	Indications	Remark/Notes
1 Calling up the parameter sequence		
		Actuate the key until CONFIG. off appears in the text line. The LED of the key is alight.
2 Opening the parameter sequence		
 (on)		The status indication is flashing.
3 Calling up the parameter		
		Actuate the key until the first parameter XTE TRIM...0 appears in the text line.

PILOTSTAR D

	Indications	Remark/Notes
4 Calling up the next parameter		
		Adjusting of the actual ship's length, see point 4 .

Repeat the operations stated under Point **4** with the following ship-specific parameters (see Annex – 4).

5 Leaving the parameter sequence		
		
6 <i>Storing new parameter values YES or NO</i>		
 1x   1x 	 	On pressing the up key once, the new parameters are stored (Y)es by activating the SET key. On pressing the down key once the new parameter are not stored by activating the SET key

4.6

Cold start

The cold start is released via the software.

In case of a cold start, all operational and ship-specific parameter values are replaced by the DEFAULT values.

4.6.1

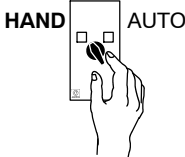
Releasing the Cold Start

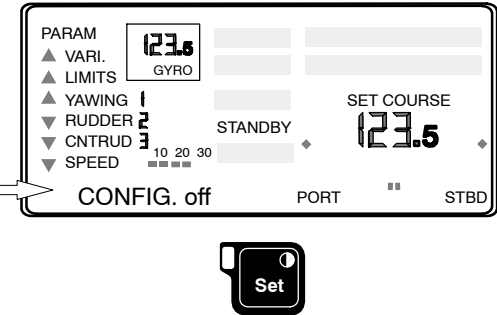
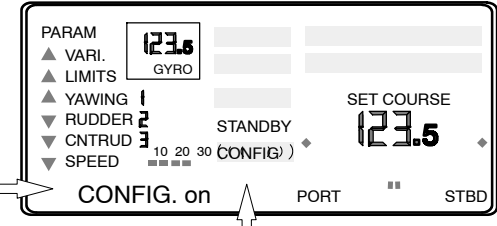
NOTE



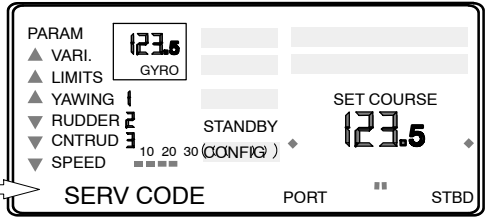
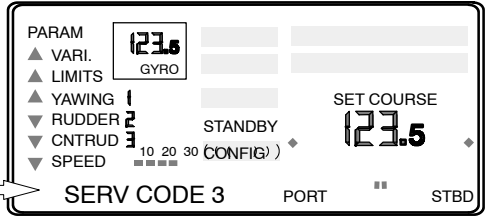
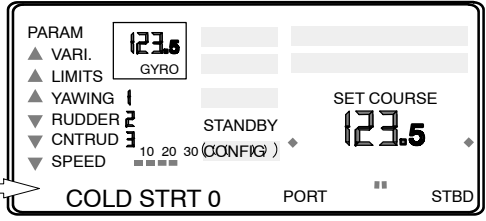
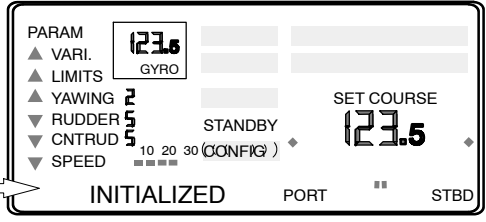
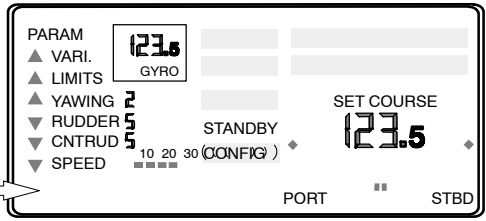
Before starting the adjustment, switch the autopilot to **STANDBY** mode.

Set the steering mode selector to **MANUAL CONTROL**.



	Indications	Remark/Notes
1 	Calling up the parameter sequence 	Actuate the key until CONFIG. off appears in the line. The LED of the key is alight.
2  (on)	Opening the parameter sequence 	The status indication is flashing.

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	Indications	Remark/Notes
3 Opening the service parameter sequence		
		Actuate the key until SERV CODE appears in the text line
4 Adjusting the service code 3		
		Actuate the key until the number 3 appears in the text line.
5 Calling up the parameter COLD STRT		
		Actuate the key until COLD STRT appears in the text line
6 Releasing the cold start		
		Actuate the key, all ship-specific parameter values are cancelled. The DEFAULT values are valid.
7 After the cold start		
		The PILOTSTAR D is now ready for operation. The ship-specific and operational parameter values are set to default and can now be entered again (s. Chap. 7.5.1). On actuating the key, the text line is masked out.

4.7 Initial Power Application and Testing of Pilotstar D, dock side test and alignment

1. The gyro compass, navigation receiver, speed log, magnetic compass and steering system should be already tested and operating.
2. Select the primary steering control system, such as "**HAND**" using the steering mode selector switch.
3. Remove the fuse from the Junction PCB of the Connection Unit (see Chapter 3.3.1).
4. Switch the ship fuse for the main supply voltage to "OFF".
Connect the power supply cable for the supply voltage at
 - B 15.3 (0V)
 - B 15.2 (+12V to 24V) or - B 15.1 (+32V).

Look for the right polarity!!!
5. Insert the fuse from the Junction PCB of the Connection Unit.
 - position F1 for 32V supply voltage
 - position F2 for 12 to 24V supply voltage.
6. Switch the ship fuse "ON". Pilotstar D should now go through its self test and then to "**STANDBY**" mode (s. Chapter 2.2.4). If the text line indicates the message "SYNCHRON" see step #12.

7. Using the  key, scroll down to "CONFIG.off".

Use the  key to change to "CONFIG.on".

Use the  key to scroll to "SERV CODE".

Use the  key to set the value to "**3**".

Use the  key to scroll to "COLD STRT".

Press the  key.

The Pilotstar D is now set to factory default values.

8. Heading sensor selection.

If the PILOTSTAR D is equipped with a gyro compass input, go to step #9.

If the Pilotstar D uses Magnetic Compass only, use the  key to scroll to

"COMPASS" and select "MAGNETIC" using the  key.

9. Using the key, scroll down to "CONFIG.off". Open the configuration menu by

using the  key to select "CONFIG.on".

10. Use the key to scroll down through the parameters. Use the key to

increase and  key to decrease the parameters.

Following are descriptions of the adjustments to be made (see also chapter "Parameter Information" at the beginning of the description).

XTE TRIM: Adjustment to be made during sea trial in special cases.
Leave at default value.

SPECI SL: Setting the ship's lengths that do not fit exactly into the
ship's lengths diagram (S_LENGTH)

RELAY ALARMS: Tiller/Alarm
in conjunction with a Central Alarm System.
Default Tiller:

RELAY Tiller	Relay switches ON if Tiller Steering is active.
RELAY Alarm	in conjunction with a Central Alarm System.
	AUTO FAIL relay active during alarm situation

FIX TURN: Switching on or off the automatic SET HEADING
presetting.

-
- FU DIFF:** To be set as required according to the Steering System.
OFF for output of rudder commands in TRANS MODE,
or whether the difference between the
set rudder and actual rudder is to be output for the
control of the steering gear (DIFF MODE).
Hereby, the control loop for the rudder position is closed
via the FU amplifier of the PILOTSTAR D.
For variation, the actual rudder signal must be fed
back via the RUDDER FEEDBACK terminal (refer to
AP02 C S01 HP050).
- S_LENGTH:** Set to closest available number to vessel length in
METERS.
- MAGFILTER:** Adjustment to be made, if required, during sea trial after
compass has been compensated – filters the Magnet LCD
indication only.
- RUD SCALE:** Set to the greatest rudder angle of the ship.
For a twin rudder system, the parameter is to be set to "95"
for a rudder angle of 35° or 100 for a rudder angle of 45°.
- RUD SLACK:** Similar to "Anti-Hunt". Increase setting if there is lost
motion in the steering gear causing the rudder to hunt or
oscillate rapidly.
Should also be tested and adjusted, if necessary, in case of
two pump operation.
- RUD LEAD:** Controls the proper stopping point of the rudder. If the
rudder overshoots 0 ° (midships) from a $\pm 10^\circ$ rudder angle,
this parameter should be increased.
If the rudder makes an intermediate stop, the "RUD LEAD"
should be decreased.
- RUD SPEED:** To be set only in conjunction with the rudder response.
Speed of the rudder in degrees per second. This can be
found by timing the movement of the rudder from 25° port to
25° starboard and dividing 50° by the time recorded.

RUD FAIL: Threshold for the alarm which monitors rudder response.
The Feedback unit must be installed to enable this function (s. Chapter 4.8).
The number selected is the difference between rudder order and rudder angle which will sound the alarm. A setting of "0" turns this function off.

CRS TYPE: Set per Annex – 3.

NAV TYPE: Set per Annex – 3. A setting of 2 or 3 is recommended.
Refer to corresponding GPS description.

LOG TYPE: Set per Annex – 3.
Parameter value $\hat{=}$ LOG 200 Pulse/nm
Parameter value $\hat{=}$ NMEA LOG seriell
The following Telegramm sentences will be accepted:
- \$IIVTG (Speed over Ground, Actual Track)
- \$IIVHW (Speed made Ground)
Setting 3 is for future options and is not functional.
Refer to corresponding LOG Sensor description.

MAG TYPE: Set per Annex – 3.

SER OUT: Set to "A-REP" if a Raytheon Anschuetz analog repeater is connected to the pilot.
Set to D-REP for Anschuetz Digital Navigation Display (digital repeater – multi function).

11. Store the parameter settings.

Press the  key until "STORE? sel (Y/N)" appears in the text line.

The display switches to "STORE (Y) SET" by pressing the  key once.

The setting is stored by pressing the  key, "Data stored".



12. If the gyro compass has a step heading output, scroll up to "SYNCHRON".

Using the  and  keys, synchronize the gyro indication with the gyro compass.

If the gyro compass is a Raytheon Anschütz Gyro, verify that the gyro compass heading matches the gyro indication.

Note



If the Pilotstar D is provided for analog output and Anschütz rudder angle indicators and feedback unit are not used, step **#13**, **#14**, **#15**, **#16** and **#17** can be bypassed.

13. (see Chapter 4.8.1)

14. (see Chapter 4.8.1.1)

15. (see Chapter 4.9)

16. (see Chapter 4.9.1)

17. Using the primary steering system, check the rudder angle indicators for correct direction and scale.

- 17.1 Change the mode switch to the "**AUTO**" position and press the  key.

The  LED should now illuminate. The operating mode **Manual** control is active.

- 17.2 Using the heading setting knob, order 20° of rudder and ensure that the rudder moves in the proper direction and to the proper position.

The rudder angle indicator shows the correct direction.

If the rudder moves backwards, reverse the port and starboard solenoid wiring and check again.

- 17.3 Press the  key. The  LED should now illuminate and the rudder will move to zero degrees.
The "SET HEADING" display should match the heading indication in the upper left corner.
- 17.4 Increase the SET HEADING about 10° port (using the heading setting knob).
The rudder should now move to approximately 10° port.
- 17.5 Press the  key. The  LED should now illuminate (operating mode **Manual** control is active).
The rudder should return to zero.
- 17.6 Press the  key. The  LED should now illuminate (operating mode **Automatic** control is active).
The rudder should remain at zero degrees.
- 17.7 Increase the SET HEADING about 10° starboard (using the heading setting knob).
The rudder should now move to approximately 10° starboard.
- 17.8 Press the  key. The  LED should now illuminate.
The rudder should return to zero degrees.
18. At the navigation receiver, enable the output sentence selected in step #9-NAV TYPE.
The "TRACK HEADING" should be +/- 60° of ship's heading.
- 18.1 Press the  key. The  LED should now illuminate.
The audible alarm will sound.
The text line will now display "XTE meter" indicating the cross track error for approximately 3 seconds.
This will be followed by the message "NEW TRACK XXX" which indicates heading of the track.

Pressing the  key will extinguish the red "ALARM" LED, and send the track heading to the "SET HEADING" indication.
This indication should now be the same as that displayed on the navigation receiver.

Note

Possible alarms and causes:

"NAVDATA FAIL":

The Pilotstar D is not receiving any data from the navigation receiver. Possible causes include broken or incorrectly connected wiring, reversal of input to Pilotstar D Connection Unit, selection of RS-232 rather than RS-422 at navigation receiver or output port of Navigation receiver not enabled (refer to corresponding GPS description).

"Nav Data Invalid":

The Pilotstar D is receiving data from the navigation receiver, but the data is erroneous. Possible causes include poor signal at receiver or no waypoint or route selected (refer to corresponding GPS description).

19. Automatic adjustment of the PILOTSTAR D to the vessel's speed.

Press the  key until "SPEED ..." is displayed.

Test/Error diagnosis when different log sensor units are used:

- Switch the log sensor to test mode (see handbook of log sensor).
The speed setting which is simulated via the test mode must now appear in the speed SPEED display of the operator unit
After the test, leave the test mode!
- If there is a combined navigation receiver (position- and log sensor), it is also possible to test the log transmission using the test mode (see handbook of the navigation receiver). If the display is incorrect, see step #18.1.
- Error diagnosis for the pulse log transmission (200 pulses per mile).
First the external wiring must be removed (B25.2. and 25.3).
When the connection terminals are temporarily bridged, the SPEED display in the operator unit should show an increasing speed when the PILOTSTAR D is working properly.

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If this should not be the case, repeat the test on the PILOTSTAR D as follows:

- Observe the LED H5 on the CPU PCB.

If this LED flashes with the on and off action of the jumper, then probably the wrong interface format has been set (see step #9 LOG TYPE).

20. Press the  key, the LED will now illuminate.

Using the rotary knob, enter a rudder order of 20° and allow the rudder to respond and stop.

Now order 0° and check for

- any hunting
- intermediate stops
- over shoot

Corrections see step #9 RUDDER SLACK or RUDDER LEAD as required.

21. Using a rudder value of >20°.

Press both   keys below.

The rudder should return to zero degrees without overshoot or intermediate stopping. Repeat step #20 if necessary.

22. Check the correct rudder movement.

Press the  key. The rudder responds correctly to starboard.

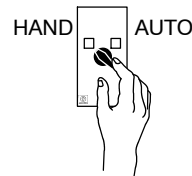
23. The Pilotstar D is now ready for sea trials.

4.8

Installation of the Feedback Unit (Type 101-529)**NOTE**

Prior to adjustment, the autopilot is to be switched into the STANDBY mode.

Set the steering mode selector to **MANUAL CONTROL**.

**Measuring instrument:**

A commercial voltmeter is to be made available as a measuring instrument.

Pre-condition:

The feedback unit has been mounted according to Dimensional Drawing 101-529 HP006 and electrically connected (with a toothed-belt transmission, the belt pulley is centrally to be mounted onto the rudder stock).

The casing cover is to be removed.

The connection box has been mounted according to Dimensional Drawing 102-863 HP005 and electrically connected.

4.8.1

Adjusting the Feedback Potentiometer

(See Circuit Diagram 101-529 HP007)

The feedback potentiometer (R3) is axially connected to the pulley (s. Fig. 4-1).

Pre-condition:

Set rudder to exactly midships position (0°) via manual control.

Connect the voltmeter (DC measuring range) to the following test points (TP):

TP 1 $\cong$ $\perp$

TP 2 $\cong$ +

The voltmeter will indicate a voltage level of between ± 10 V.

Balancing:

Turn the pulley until the voltmeter reads 0V.

Mounting the transmission element:

- Linkage transmission

By loosening the hexagonal screw on the pulley, the pulley position can adequately be corrected.

- Toothed-belt transmission

The toothed belt can directly be applied.

Pay attention to the belt tension indicated in the dimensional drawing.

Following the adjustment/mounting, the test lines are to be removed.

4.8.1.1 Adjusting the Limit Switches of the Feedback Unit

(See Feedback Unit PCB 101-529 HP010)

The limit switch relay of the feedback unit (PORT and STARBOARD) have to react switch before the mechanical limit stops of the steering gear.

Port limit switch relay:

Adjust the rudder by manual control for the desired cut-off angle.

Turn the potentiometer R2 until H2 LED is switched off.

Starboard limit switch relay:

Adjust the rudder by manual control for the desired cut-off angle.

Turn the potentiometer R1 until H1 LED is switched off.

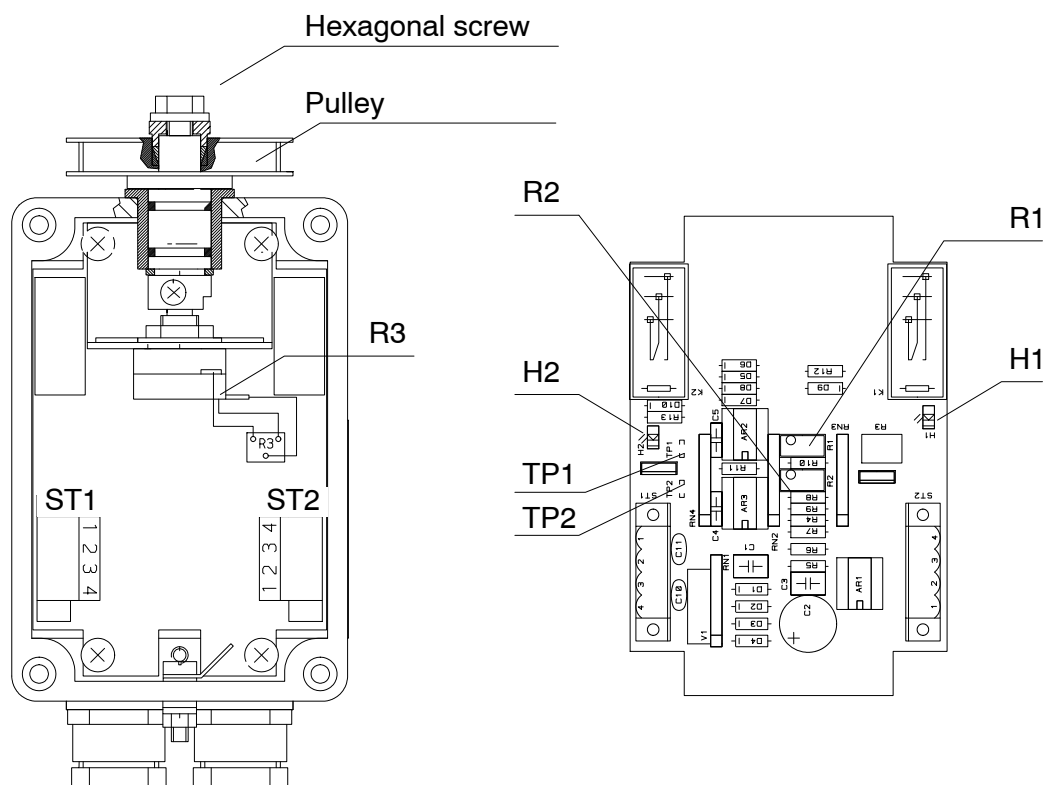


Fig. 4-1: Balancing the Feedback Unit, Typ 101-529

4.9 Electrical Zero Adjustment on the I/O PCB (OFFSET) (refer to summary diagram 102 D 863 HP011)

Pre-conditions:

Set rudder to exactly midships position (0°) via manual control.

Connect the measuring instrument to the following test points (TP):

TP 1 $\cong$ $\perp$

TP 16 $\cong$ $+$

Adjustment:

Turn the potentiometer R39 (on the I/O PCB) until the voltmeter indicates 0V.

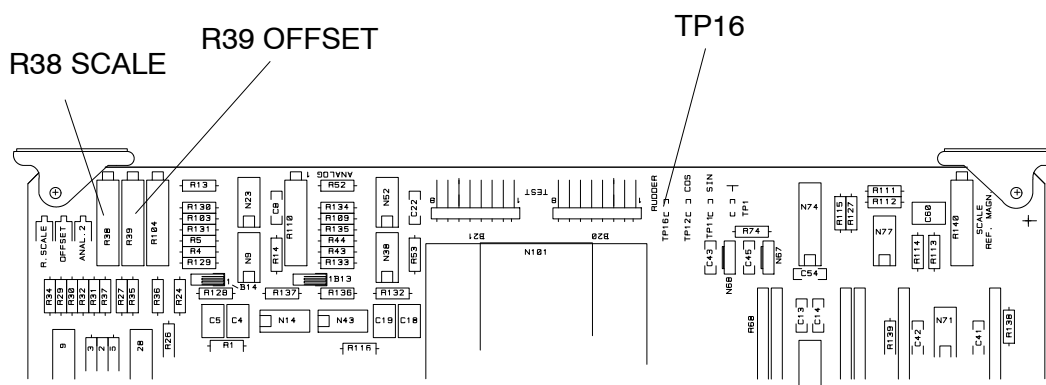
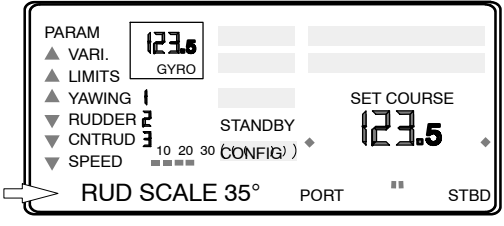


Fig. 4-2: Adjustment on the I/O PCB

4.9.1

Adjustment and Test of the Electrical Rudder Scaling (RUD SCALE)

	Indications	Remark/Notes
1	Calling up or checking the parameter RUD SCALE	
		For calling up the parameter sequence, see Chapter 4.5.1, Point 1. In this example, the default value corresponds to the ship-specific value. Subsequently, close the parameter sequence via CONFIG. off (see Chapter 4.5.1, Point 6).

For the electrical adjustment of the rudder setting range, the rudder is always to be moved to the maximum rudder angle according to RUD SCALE for PORT/STBD.

For this, the rudder angle can be adjusted by **manual control** or by **autopilot** (e.g. if no steering mode selector is available)

Pre-conditions: See Chapter 4.8

Adjustment by manual control:

Adjust the maximum rudder angle for STBD, e.g. 35°.

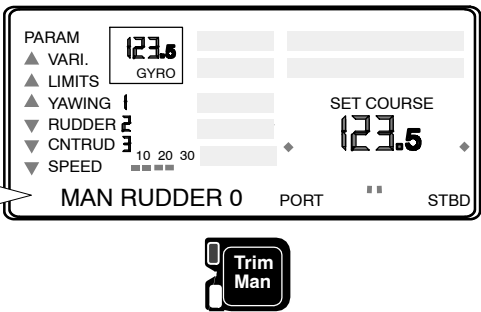
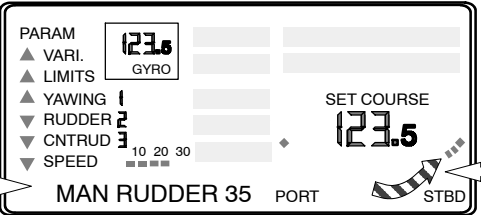
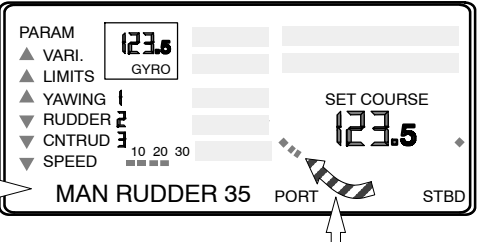
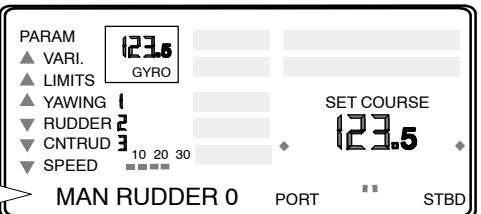
Turn the potentiometer R38 (on the I/O PCB) until a voltage level of between **-2.3V** and **-2.5V** appears on the voltmeter.

Repeat the measurement with a maximum rudder angle for PORT.

The voltmeter has to indicate a voltage level of between **+2.3V** and **+2.5V**.

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Adjustment by autopilot function:

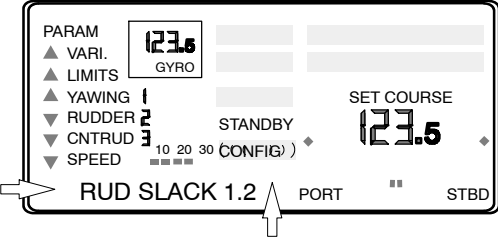
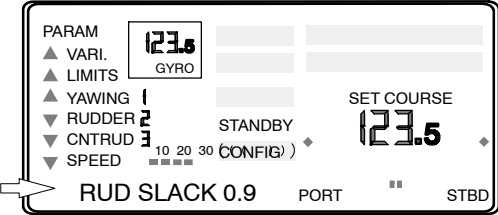
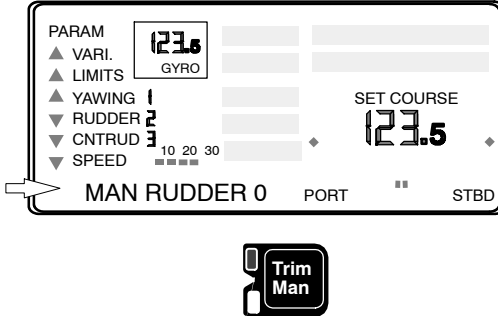
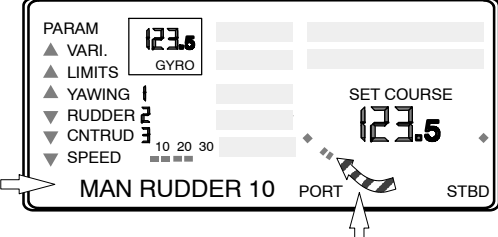
	Indications	Remark/Notes
1 Calling up manual operating mode		
		Prior to calling up the manual operating mode, the steering mode selector has to be set to position AUTO.
2 Adjusting the maximum rudder angle of e.g. 35° STBD		
		On actuating the key, the bar graph segment moves towards the STBD stop. Adjustment: Turn the potentiometer R38 (on the I/O PCB) until a voltage level from -2.3V to -2.5V appears on the voltmeter.
3 Adjusting the maximum rudder angle of e.g. 35° PORT		
		On actuating the key, the bar graph segment moves towards the PORT stop. The voltmeter indicates a voltage level of +2.3V to +2.5V .
4 Adjusting the rudder in the fore-and-aft line		
		On actuating both keys, the bar graph segment moves to midship position.

Adjustment terminated:

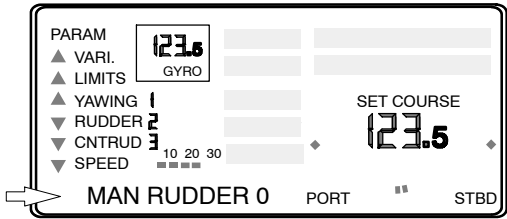
Remove the test lines.

4.9.1.1

Adjusting/Checking the Rudder Slack (RUD SLACK)

	Indications	Remark/Notes
1	Calling up the parameter RUD SLACK	
		For calling up the parameter sequence, see Chapter 4.5.1, Point 1 .
2	Adjusting the parameter value RUD SLACK, e.g. 0.9	
		Adjust a parameter value that ensures a stable rudder position (0.3, 0.6, 0.9, 1.2, ... 3). In case of steering gear with 2 pumps, the adjustment has to be performed with both the pumps connected. Subsequently, close the parameter sequence via CONFIG. off (see Chapter 4.5.1, Point 6).
3	Checking the RUD SLACK effect; calling up manual operating mode	
		Prior to calling up the manual operating mode, the steering mode selector has to be set to position AUTO .
4	Adjusting the rudder e.g. for 10° PORT	
		

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	Indications	Remark/Notes
5 Adjusting the rudder in the fore-and-aft line		
 		On actuating both keys, the rudder shall move into midship position without considerable over-swings and assume a stable rudder position. A continuous oscillation of the steering gear is to be compensated by augmenting the RUD SLACK parameter value, see Point 1 .



4.10

Adjusting the Magnet Sonde 108-010**Test Equipment:**

A normal voltmeter must be available as test equipment (DC range)

Requirement:

The magnetic probe of type 108-010 has already been assembled in accordance with the assembly instructions.

Check the valency (1) of the ship specific parameter MAG TYPE (refer to Chap. 4.5.1 and appendix - 4).

Select the MAG COMPASS type on the control panel.

The parameter value for VARIATION must be 0°.

Check whether the signal inputs of the fluxgate terminal (B26 on the terminal PCB) are bridged.

Adjusting procedure:**If the I/O PCB has no R140 (SCALE REF. MAGN) potentiometer**

Connect the voltmeter to the following test points (TP):

TP1	$\cong$	$\perp$
TP12	$\cong$	+ (COS)

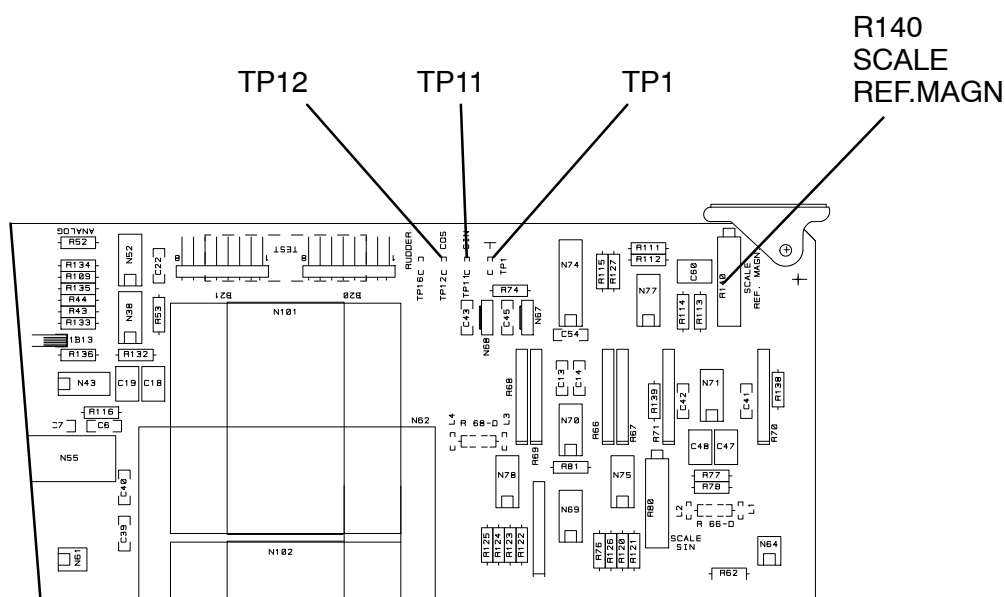
- 1) Turn the probe in its holder until the actual heading display in the LCD display panel shows 0°. The voltmeter must now display a voltage between - 4.9 and - 5.9 V. If the voltage is < - 4.9V, then the distance between the magnetic compass and the probe must be decreased (shorten the spacing pieces). If the value is > - 5.9V, then a set of extended spacing pieces must be used.
- 2) Turn the probe slowly in its holding ring until the actual heading display (PILOTSTAR D) is identical to that of the magnetic compass heading.

(In this setting, check the sense of rotation of the phases):

- if the probe is turned in the direction of higher magnetic compass values, then the actual heading display must be correspondingly larger. If the sense of rotation is incorrect, then probe connections S1 and S3 must be swapped.)

The probe is screwed in at this location.

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Adjusting procedure:

If the I/O PCB has an R140 (SCALE REF. MAGN) potentiometer

(refer to composition diagram 102 D 863 HP011)

Connect the voltmeter to the following test points (TP):

$$\begin{array}{lcl} \text{TP1} & \cong & \perp \\ \text{TP12} & \cong & + (\text{COS}) \end{array}$$

- 1) Turn the probe until the voltmeter shows a maximum voltage value. Adjust potentiometer R140 until a voltage of +5.5V (-5.5V) appears.
- 2) Turn the probe slowly in its holding ring until the actual heading display (PILOTSTAR D) is identical to that of the magnetic compass heading.

(In this setting, check the sense of rotation of the phases):

- if the probe is turned in the direction of higher magnetic compass values, then the actual heading display must be correspondingly larger.
If the sense of rotation is incorrect, then probe connections S1 and S3 must be swapped.)

The probe is screwed in at this location.

4.11

Adjusting the Flux-gate Compass Sonde (with SIN/COS Output)

Notes for a flux-gate compass sonde with a serial data transmission:

For this compass type, no adjustment is required.

The ship-specific parameter MAG TYP (see Chapter 4.5.1 and Annex - 4) has to be adjusted for the value **2**.

Measuring equipment:

A commercial voltmeter is to be made available (PC range).

Pre-condition:

Check the significance (1) of the ship-specific parameter MAG TYP (see Chapter 4.5.1 and Annex - 4).

Adjust the COMPASS Type MAG via the operator unit.

Make shure that the "Variation" parameter is 0°.

Measuring / Adjustment:

(refer to summary diagram 102 D 863 HP011)

Connect the voltmeter to the following test points (TP):

TP1 $\hat{=}$ $\perp$

TP12 $\hat{=}$ - (COS)

Turn the flux gate until the heading indication in the LCD display indicates **0°**.

The voltmeter have to indicate a voltage of - 4,9 -5,9V.

If the value is >-5,9V, the value has to be reduced via an additional input resistor (terminal B26.5 and B26.3).

Example of calculation :

For a reduction by the factor 2, a resistor of 100 k Ω is to be built-in.

Alternative measurement

Connect the voltmeter to the following test points (TP):

TP1 $\hat{=}$ $\perp$

TP11 $\hat{=}$ - (SIN)

Turn the flux gate until the heading indication in the LCD display panel is **90°**.

The voltmeter have to indicate a voltage of -4,9 -5,9V.

4.12

Sea Trial Procedure

Note



The following procedures and adjustments are made at the time of installation only and are "ship specific". For the best possible performance and continued efficient operation, sufficient time must be allowed, usually a minimum of 4 hours. If the necessary trials are cut short for any reason, the vessel's owner should be notified that the pilot may be operating at a level that is below the design capabilities.

1. Ensure that all of the supporting equipment is operating properly (such as gyro, log...).
The vessel should be at normal operating speed.
The vessel should be steering into the prevailing sea or current during the initial tests. Set the rate to turn parameter to 30°/MIN. Set the parameter value step by step by the sea trial procedure to an higher value (make some heading changes).
2. When the vessel mode selection switch is switched from "HAND" to "AUTO" (LED  lights up), the PILOTSTAR D operates with standard values for YAWING, RUDDER, CNT.RUD.
If the rudder shows unstable behavior (oscillation) immediately after changeover, the parameter value for "RUDDER" must be reduced step by step.

The vessel should now continue on a stable heading. SET HEADING is the same as ACTUAL HEADING.
3. Make several 10° heading changes each. Observe the heading change maneuver with respect to the following criteria:
 - The vessel must not react too quickly or too slowly to the new SET HEADING setting. If the heading change is too rapid, the ship will oscillate around the new heading.
 - Increase the "CNT. RUD" value by 1.
Repeat the heading change maneuver.
 - If this behavior cannot be compensated by this parameter value, reduce the parameter value for "RUDDER" step by step.
Repeat the heading change maneuver.

- If this behavior cannot be compensated by this parameter value either, then set the parameter value for "S_LENGTH" to the next highest value.
Repeat the heading change maneuver.

If the heading change is too slow, the ship will cease to turn shortly before reaching the SET HEADING setting.

- Reduce the "CNT. RUD" value by 1.
Repeat the heading change maneuver.
- If this behavior cannot be compensated by parameter value, increase the parameter value for "RUDDER" step by step.
Repeat the heading change maneuver.
- If this behavior cannot be compensated by this parameter value either, then set the parameter value for "S_LENGTH" to the next lower value.
Repeat the heading change maneuver.

Storing the optimized parameters:

Press the  key until "STORE? sel (Y/N)" appears in the text line.

The display switches to "STORE (Y) SET" by pressing the  key once.

The setting is stored by pressing the  key, "Data stored".

4. Make some additional heading maneuvers; turn the vessel into the wind.
Observe the heading stability of the vessel.
The PILOTSTAR D begins to compensate the drift effect (rudder offset begin).
If the rudder offset takes effect too slowly, the parameter must be increased.

Press the  key until "CONFIG.off" appears in the line of text.

When the  key is pressed, the parameter series for the ship-specific parameter series is released ("CONFIG.on").

Press the  key until "SERV CODE" appears in the line of text.

Press the  key until "SERV CODE 3" appears in the line of text.

Press the  key until "autotrim ..." appears in the line of text.

Press the  key until optimal control behavior is achieved.

Make a heading change of 180° and check the heading behavior.

Press the  key until "ex?=1" appears in the line of text.

When the  key is pressed, the service menu is left; a previously changed parameter setting is not stored.

If a new parameter value is to be stored, "CONFIG. on/off" must be called up (see #3).

5. On the navigation receiver, define a route of 3 way points and two legs. Refer to the navigation receiver's manufacturers manual regarding this operation. Each leg of the route should be a minimum of 10 nautical miles in length. The track course of first leg should be directly into the prevailing sea and wind. The track course for second leg should be +/- 90° of the first leg.
- 5.1 Steer the vessel as close as possible to the first way point using heading control (angular range approx. $\pm 60^\circ$).

Press the  key and the  LED will now illuminate accompanied by the red  LED and an audible alarm will sound.

The text indication will read "xte meter ..." for approximately 3 seconds and will be replaced by "NEW TRACK ...". Pressing the  key will accept the track and write the track course to the "SET HEADING" indication.

The SET HEADING indication will now retain the same value until the track has been completed or superseded. Observe the track keeping ability of the pilot for a minimum of 20 minutes. If the pilot does not stay close enough to the track line, increase the "TRACK <>" parameter until the vessel requirements are satisfied.

Storing the optimized parameters:

Press the  key until "STORE? sel (Y/N)" appears in the text line.

The display switches to "STORE (Y) SET" by pressing the  key once.

The setting is stored by pressing the  key, "Data stored".

5.2 The course change

When the second waypoint is reached, the acoustic alarm sounds.

(In case of a position receiver with XTE transmission, there is no automatic alarm and display; see chapter 2.2.8.3)

The text indication will read "xte meter ..." for approximately 3 seconds and will be replaced by "NEW TRACK ...". Pressing the  key will accept the track and write the track course to the "SET HEADING" indication.

The SET HEADING indication will now retain the same value until the track has been completed or superseded.

Observe the course change maneuver.

If the vessel cannot reach the track or if the vessel begins to oscillate around the new track course, increase the "XTE TRIM" parameter value.

If the vessel begins to swing slowly over the track, reduce the "XTE TRIM" parameter value (see chapter 2.4.1).

After completion of the second track leg the track follow-up can be ended.

Press the  key. Reverse the waypoint of the route previously covered.

Upon completion of the first leg, switch to auto and bring the vessel within +/- 60° of the next track course and go to .

Check the quality about the track and the course change maneuver.

6. The setting of parameter is now completed.
It is advisable to enter all ship-specific parameter values in the tables of the Appendices - 2 and - 3 in writing.

In case of a possible defect, for example of the CPU PCB, the parameter values can be updated quickly after changing the PCB.

4.13

A Guide to when which Parameters must be Set

✱ marked parameters must be set every time the ship is put into operation in the harbour or during test runs. The parameters should be noted in the appropriate areas.

No.	Parameter	When	Why	How
1	COMPASS	Initial putting into operation (e.g. setting magnetic compass or gyro compass) or in case of a defective heading sensor.	Heading sensor serves as heading reference for the PILOTSTAR D. Note: This parameter is not shown when only for the gyro compass or the magnetic compass.	2.1.5
2	VARIATON	For a magnetic compass. Note: The parameter is only not shown in case of the gyro compass.	Compensates for errors from the magnetic compass. The value results from the combined magnetic heading correction value VARIATION (see sea chart) and from the DEVIATION value taken from the deviation table referred to the ship (operational parameter).	
3	TRACK LIM	TRACK operating mode. <u>Setting</u> At which track error an alarm is to be generated.	Used to ensure track monitoring. Defines the monitoring limits to the left or right of the track. An OFF TRACK warning is emitted when a limit is reached.	2.3.2
4	OFF HEAD-ING	HEADING CONTROL operating mode. <u>Setting</u> At which track error an alarm is to be generated.	Used to ensure HEADING CONTROL. Defines the monitoring limit for the set heading/actual heading deviation in HEADING CONTROL operating mode. An OFF HEADING warning is emitted when the limit setting is exceeded.	2.3.3
5	RoT° / MIN	Feature is active when in HEADING CONTROL and TRACK operating modes.. <u>Setting</u> As required	Defines the rate of turn for the ship during a heading or track change manoeuvre.	2.3.1
6	RUD.LIM	HEADING CONTROL or TRACK operating mode.	With this value, the maximum permissible rudder position in degrees is to be adjusted, which, for safety reasons, must not be exceeded by the steering gear during autopilot operation.	2.3.4
7	YAWING TRIM YAW	HEADING CONTROL or TRACK operating mode. <u>Setting</u> Dependent on swell.	The YAWING setting defines the rudder activity and the heading accuracy of the PILOTSTAR D. The optimal setting is determined from the conditions: YAWING tendency = 1, means control with the greatest activity (maximum amplification factor) YAWING tendency = 6, means control with the least activity (minimum amplification factor) When not set correctly, the steering gear can be overworked. Off- headings are caused by large rudder angles.	2.3.1.1
8	RUDDER TRIM RUD	HEADING CONTROL operating mode. <u>Set during</u> Initial putting into operation, test run	Every heading deviation must be corrected by a rudder value <u>specific to the ship</u> . The RUDDER setting defines the relation between the rudder angle and the heading error. RUDDER tendency <u>too great</u> : - unstable behaviour ► over-reaction during a heading correction ► overswing during a heading change RUDDER tendency <u>too low</u> : - Heading control too inaccurate ► preset R.o.T. not achieved during heading change manoeuvre.	2.3.1.1

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No.	Parameter	When	Why	How
9	CNT.RUD TRIM CNT	HEADING CONTROL operating mode. <u>Set during</u> Initial putting into operation, test run	Every ship has its own time constant, depending on its mass and load. This constant must be observed during a heading change manoeuvre. Before reaching the new set heading, the R.o.T. must be minimised on time (e.g. by counter rudder). This effect is set by the counter rudder (CNT.RUD). Tendency – <u>counter rudder too great</u> : Ship overshoot avoided before reaching the new set heading. Tendency – <u>counter rudder too low</u> : The ship is not stopped on time and overshoots the preset heading.	2.3.1
10	SPEED	When there is no log sensor on board, the current speed must be set manually.	The ship's behaviour depends on its speed. To ensure optimal control, the controller must be adjusted for the speed.	2.3
11	TRACK< >	TRACK operating mode. <u>Setting</u> - track deviation is too great (drift) - too much gain in track controller.	Tendency – <u>not enough gain in track controller</u> : Drift influences are strong and result in a greater track deviation. Accuracy can be increased by the amplification setting (greater) TRACK > . Tendency – <u>too much gain in track controller</u> : Reduce the amplification setting via TRACK< until the required setting is reached. Optimum between accuracy and controller gain (heading trim).	2.3.5
12 ✱	SYCHRON.	No absolute heading transmission from the heading sensor (gyro compass) to the PILOTSTAR D is used. <u>Set</u> - during initial putting into operation - desynchronization after power failure	The heading display between the compass and the PILOTSTAR D is desynchronized.	2.3.6
13	XTE TRIM	TRACK operating mode. <u>Set when</u> The track controller is not yet functioning optimally.	The temporal coordination of the track error compensation has not been correctly adjusted. Track error correction is too slow or too fast (see figure in Chap. 2.4.1).	2.4.1
14 ✱	SPECI SL	HEADING CONTROL operating mode. (test run). <u>Set during</u> Initial Putting into Operation. Heading behaviour is still not optimal after a change in heading. A stepwise increase in previous measure CNT.RUD and a stepwise decrease in RUDDER is unsuccessful.	In most cases, an approximate entry of the ship's length (S_LENGTH) fulfils the requirements of the PILOTSTAR D for an optimal heading control. SPECI SL is available for special cases. With this feature, the ship's length can be increased or decreased as a percentage, whereby the temporal control behaviour is influenced. The resulting ship's length must not necessarily correspond to the original length .	2.4.1

No.	Parameter	When	Why	How
15	RELAIS Tiller or Relais Alarm (Central Alarm System)	<u>Set during</u> Initial Putting into Operation. Basic setting in the harbour. Tiller on = when the tiller status is to be indicated via an external status indication. Alarm Reset = when an external alarm system for acknowledging/indicating an alarm message is to be used.	PILOTSTAR D must be adapted to the system configuration (Central Alarm System). } Summary of acoustical/optical alarms	2.4.1
16	FIX TURN	HEADING CONTROL operating mode. <u>Set</u> When a fixed set heading change is to be immediately executed on pressing a key.	Makes certain manoeuvres simpler.	2.2.6.2
17 ✱	FU DIFF	<u>Set during</u> Initial Putting into Operation. Basic setting in the harbour. Only required in case of analog rudder control. FU DIFF= 0 means that set rudder output is required. FU DIFF= 1...8 means that the difference between the set rudder and actual rudder is required for control.	The difference between the set rudder and the actual rudder can be made up by the FU amplifier of the PILOTSTAR D. The amplification factor can be set (FU DFF 1..8). If no difference is required, the parameter must be set to 0. The controller must be adjusted to the ship and on the rudder dynamics (difference mode active). Tendency – amplification <u>too great</u>: - the rudder does not assume a stable position. Tendency – amplification <u>too low</u>: - the control is too inaccurate	2.4.1
18 ✱	S_LENGTH	<u>Set during</u> Initial Putting into Operation. Basic setting in the harbour.	The <u>approximate</u> entry of the ship's length defines the control behaviour of the PILOTSTAR D. If the heading behaviour of the PILOTSTAR D is not optimal, then fine adjustment via SPEC SL is required.	2.4.1
19 ✱	MAG FILTER	Set during by instable Magnet- or Fluxgate-indication. <u>Set during</u> Initial Putting into Operation. Basic setting in the harbour.	It depends about the sensor storage. The filter will be inserted for signal smoothing. Total range controller output 1 ... 10 (1 for minimum filtering).	2.4.1
20 ✱	RUD SCALE	<u>Set during</u> Initial Putting into Operation. Basic setting in the harbour.	PILOTSTAR D must be adjusted to the maximum adjusting range of the available steering gear.	4.9.1
21 ✱	RUD SLACK	<u>Set during</u> Initial Putting into Operation Basic setting in the harbour.	Setting the rudder slack. Hereby, the rudder angle controller of the PILOTSTAR D is adjusted to the rudder dynamics of the steering gear. The rudder slack should be increased during "rudder hunting".	4.9.1.1
22 ✱	RUD LEAD	<u>Set during</u> Initial Putting into Operation. Basic setting in the harbour.	In case of steering gears with large temporal delays, the rudder command HALT results in a rudder follow up. A rudder correction is generated via the RUD LEAD setting, allowing the rudder to be prematurely switched off. The required rudder setting is thereby obtained together with the follow up of the steering gear.	2.4.1

PILOTSTAR D

No.	Parameter	When	Why	How
23 ✱	RUD SPEED	<u>Set during</u> Initial Putting into Operation. Basic setting in the harbour. When using the rudder angle monitoring (STEERING FAILURE).	The rudder speed is used to calculate the control time during a rudder command. If the t_{set} time is exceeded substantially, an alarm is triggered. The RUD SPEED and RUD FAIL parameters are dealt with together.	2.4.1
24 ✱	RUD FAIL	<u>Set during</u> Initial Putting into Operation. Basic setting in the harbour. The steering gear system should also be monitored, (Steering Failure) Set rudder=actual rudder after t_{set}	Additional safety by monitoring the steering gear and the feedback system. The tolerance range can be set in steps from 1 to 9 degrees.	2.4.1
25 ✱	CRS TYPE	<u>Set during</u> Initial Putting into Operation. Basic setting in the harbour.	PILOTSTAR D must be set to the physical interface of the gyro compass system.	2.4.1 Appen.
26 ✱	NAV TYPE	<u>Set during</u> Initial Putting into Operation. Basic setting in the harbour.	PILOTSTAR D must be adapted to the ship-specific navigation receiver. For list of available telegramme types, refer to the Navigation Receiver Manual.	2.4.1 Appen.
27 ✱	LOG TYPE	<u>Set during</u> Initial Putting into Operation. Basic setting in the harbour.	PILOTSTAR D must be adapted to the ship-specific log sensor. For list of available transmission, refer to the Log Sensor Manual.	2.4.1 Appen.
28 ✱	MAG TYP	<u>Set during</u> Initial Putting into Operation. Basic setting in the harbour.	PILOTSTAR D must be set to the physical interface of the magnetic or fluxgate compass system. Sonde or coursebus transmission.	2.4.1 Appen.
29 ✱	SER OUT	<u>Set during</u> Initial Putting into Operation. Basic setting in the harbour. If a repeater system is to be connected to the PILOTSTAR D	A digital or an analog repeater indicator can be connected to the PILOTSTAR D. According to the type of R-Anschütz repeater indicator, the corresponding output interface must be connected.	2.4.1 Appen.
30	CHECK-SUM	Information. Checksum for data transmission of control unit and connection box.	Internal functional check.	2.4.1
31	sin mag...	Information. When the external signal feed (magnetic compass-PILOTSTAR D) is to be checked.	Functional check. Indicates the coded sin magnetic compass signal. No coded signal: transmission path or compass defective.	2.4.1 Appen.
32	cos mag...	Information. When the external signal feed (magnetic compass-PILOTSTAR D) is to be checked.	Functional check. Indicates the coded cos magnetic compass signal. No coded signal: transmission path or compass defective.	2.4.1 Appen.
33	remote	Information. When the external signal feed (REMOTE-MODE) is to be checked.	Functional check. Indicates the hardware status 0= no remote operation 1= free for remote operation	2.4.1 Appen.
34	act.rud...	Information. When the external signal feed (from the feedback unit) is to be checked.	Functional check. Indicates the actual rudder setting from the sensor in "1/10°" above the feedback unit. Rudder offset and rudder scaling can be adjusted.	2.4.1 Appen.

No.	Parameter	When	Why	How
35	rudsw/min	Information. In case of NFU rudder control (Bang-Bang control). Test run required.	Functional check. Checks the RUD SLACK setting. The switch pulses / min for the steering gear are counted and indicated. A reduction in RUD SLACK increases rudder activity and thereby the accuracy of the control. Attention: Rudder Hunting occurs when RUD SLACK selection is too low.	2.4.1 Appen.
36	tiller	Information. When the external signal feed for the selected tiller is to be checked.	Functional check of the tiller (FU / NFU) Indicates a coded rudder value, depending on the set rudder scaling (+ for starboard, - for port). Offset and ccale adjustment of the FU tiller 1/10°. NFU tiller mid-position -700, STBD approx. +672, PORT -672.	2.4.1 Appen.
37	rudcom	Information. When the set rudder output is to be checked.	Functional check. Indicates a coded set rudder value in 1/10°.	2.4.1 Appen.
38	log	Information. When the external signal feed (from log sensor) is to be checked	Functional check. Indicates the speed from the log in 1/10° KN.	2.4.1 Appen.
39	step	Special service information. When the external signal feed (from the gyro compass) is to be checked (step transmission)	Functional check. Indicates the step input from the gyro compass.	2.4.1 Appen.
40	hex 1-3	Information.	Functional check. Allows remote diagnostics via 3 callable hexcodes.	2.4.1 Appen.
41 ✱	xte i 0-2	<u>Set only in particular circumstances</u> TRACK operating mode. Special service setting for navigation receivers with XTE telegram transmission. The track controller reacts too slowly to a strong drift.	The integral component of the track controller can be increased. The increase can be carried out in 2 steps. Aim: the track error is to be better compensated for in case of stronger drift. Disadvantage: Longer settling processes can be expected in case of abrupt disturbance changes. Attention: The selected setting is deleted after a POWER DOWN. The DEFAULT value is effective after a renewed putting into operation.	2.4.1 Appen.
42 ✱	xtefi 0-1	<u>Set only in particular circumstances</u> TRACK operating mode. Special service setting for navigation receivers with XTE telegram transmission. Transmission errors from the navigation receiver.	If track error jumps occur - caused by the navigation receiver - then xtefi can be set to 1. The transmission errors are reduced by switching on an electronic filter. Disadvantage: The entire track control is less accurate. Attention: The selected setting is deleted after a POWER DOWN. The DEFAULT value is effective after a renewed putting into operation.	2.4.1 Appen.
43 ✱	autotrim	<u>Set only in particular circumstances</u> HEADING CONTROL operating mode. Heading deviations, that can only be corrected after a longer period of time, occur during a test run.	The heading controller should compensate for DRIFT EFFECTS within an adequate time. The time can be shortened or lengthened with this setting (integral component of the controller is changed). 0 = fast/250 = slow Attention: The selected setting is deleted after a POWER DOWN. The DEFAULT value is effective after a renewed putting into operation.	2.4.1 Appen.
44	cts =....	Information. When the external NMEA feed (track course) is to be checked.	Functional check. Indicates the Course to Steer from the NMEA telegram (or the track course).	2.4.1 Appen.

PILOTSTAR D

No.	Parameter	When	Why	How
45	xte meter..	Information. Indicates the track deviation in the text display.	Functional check. Indicates the Cross Track Error from the NMEA telegram and can be used for optimization of the track controller setting.	2.4.1 Appen.
46	COLD STRT	Special service activity. When all ship-specific values are to be replaced by default values (e.g. initial putting into operation)	Re-establishes a start configuration (DEFAULT values) when a configuration is defective.	2.4.1 Appen.
47	VERSION E	Check of the program version	Indicates the actual program version (in case of a software update).	2.4.1 Appen.
48	ex?=1	Return from service mode to normal mode (operator level)	Fastest possibility for leaving the service mode. Changed configuration values are <u>not</u> stored!	2.4.1 Appen.



Pos.	Lager-Nr. Stock-No.	Benennung	Designation	Zeichnungs-Nr. Part-No.	Stck. Qty.	Herst.-Code MFRC	Versorgungs-Nr. NSN
1	4002082	Bediengerät, neu grau	Operator Unit, new grey	102-864.NG003		D2865	
	4002326	Bediengerät, AT grau	Operator Unit reconditioned; grey	102-864.NG003 AT		D2865	
	4001904	Bediengerät, AT schwarz	Operator Unit reconditioned; black	102-864.NG001 E03 AT		D2865	
2	4003600	Anschlusseinheit, neu	Connection Unit, new	102-863.NG001 E04		D2865	
	4003704	Anschlusseinheit, AT	Connection Unit, reconditioned	102-863.NG001 E04 AT		D2865	
3	3600205	Verdrahtungskarte	Wiring PCB	102-863.20 E01	1	D2865	
4	3600206	Klemmenkarte	Terminal PCB	102-863.23 E01	1	D2865	
5	3610815	I/O-Karte	I/O PCB	102-863.X01	1	D2865	
6	3610437	CPU-Karte	CPU PCB	102-863.100 E04	1	D2865	

All depicted items which are not mentioned in the text are not applicable for this unit. Since further development may necessitate making modifications to existing equipment, its conformity with the relevant illustrations and drawings is not always ensured. Raytheon Anschütz will be under no liability whatever that may arise from any such differences.

PILOTSTAR D

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Annexes:

The PILOTSTAR D Operator Unit	Annex - 1
Information on the Current Parameters	Annex - 2
The Parameter Management	Annex - 3
The Parameter Management (Service)	Annex - 4

Set of Drawings:

Connection Diagram		AP02 C S01 HP051
Dimensional Drawing	Connection Unit	102 E 863 HP005
Assembly Drawing	CPU PCB	102 D 863 HP100
Assembly Drawing	I/O PCB	102 D 863 HP011
Circuit Diagram	Junction PCB	102 D 863 HP023
Assembly Drawing	Junction PCB	102 D 863 HP010
Dimensional Drawing	Operator Unit	102 D 864 HP005
Dimensional Drawing	Operator Unit	102 D 864 HP014
Dimensional Drawing	Feedback Unit	101 C 529 HP005
Assembly Drawing		101 D 529 HP006
Feedback PCB		101 E 529 HP010

Retro Package Type 102-839/840	21-CO-D-X00007-C
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Short Instruction

Intentionally left blank

Keys of the Operator Unit

LCD Display

- PILOTSTAR D

PARAM

▲ VARL.

▲ LIMITS

▲ YAWING 1

▲ RUDDER 2

▲ CNTRUD 3

▲ SPEED

123.5

GYRO

OFF TRK

OFF CRS

EXT. CRS

STANDBY

CONFIG

10

20

30

15

RUD LIMIT

Auto On/Off

Track

Trim Main

Yaw

Rud

Test

→

←

Set

Test

Opens the parameter list with the parameter **Yawing**.
Permits **paging** within parameter list in direction of arrow.

Opens the parameter list with the parameter **Rudder**.
Permits **paging** within parameter list in direction of arrow

Acknowledges the internal alarm signalling.
LED panel **alight** as long as an alarm, error or track control message is applied

Dimmer for key and LCD illumination
Varying of parameter values

Storing the operational parameters by short-time release (CONFIG. on/off)

Change-over of GYRO/MAGNETIC compass

Enabling (ON) or locking (OFF) of the parameter list found under CONFIG (PILOTSTAR configuration).

Display test (actuate both keys simultaneously)

Switches to course control (ON) when there is no steering mode selector or when the latter is in position AUTO
LED panel is alight.
Switches the operator unit into standby mode (OFF)

If existing, changes over to track control, LED panel is alight.
With any key depression, the current distance of between the ACTUAL POSITION and the SET COURSE is indicated (xte meter ...).

Switches to course control with trimming function, LED is alight.
2nd set of parameters is loaded and faded in, **Rudder limitation is cancelled**.

Changes over to manual steering control. LED panel is alight.
Rudder limitation is cancelled.

Set course pre-setting (resolution 1°) via **PORT** or **STBD keys** in the operating mode: Course control or course control with trimming function or in the operating mode: Manual control, dodge function (emergency turn) with direct rudder activation (resolution 1°).

Masks out the text line, the pointer of the parameter list is set to list start (see. Annex 3-2)
Within the CONFIG parameter list the text line cannot be masked out!

Acknowledges the adjusted synchronization value (only with step transmission)
LED panel is alight with any parameter fading-in

Actual heading indication with indication of heading sensor

Continuous indication of most widely used parameters

Indicates the controller parameter values for 1st or 2nd set of parameters

Text line; indicates the corresponding parameter and fades in alarm or disturbance messages as a plain text information

With normal operation, the status indication is dark. The status indication flashes on opening or modifying the ship-specific CONFIGURATION. As a rule, the ship-specific data will be modified only with first putting into operation or in case of system extension.

Rudder angle indication (rudder blade) with preset rudder limitation (resolution 2°)

Indicates track deviation in nm.
Indicates the preset monitoring limits

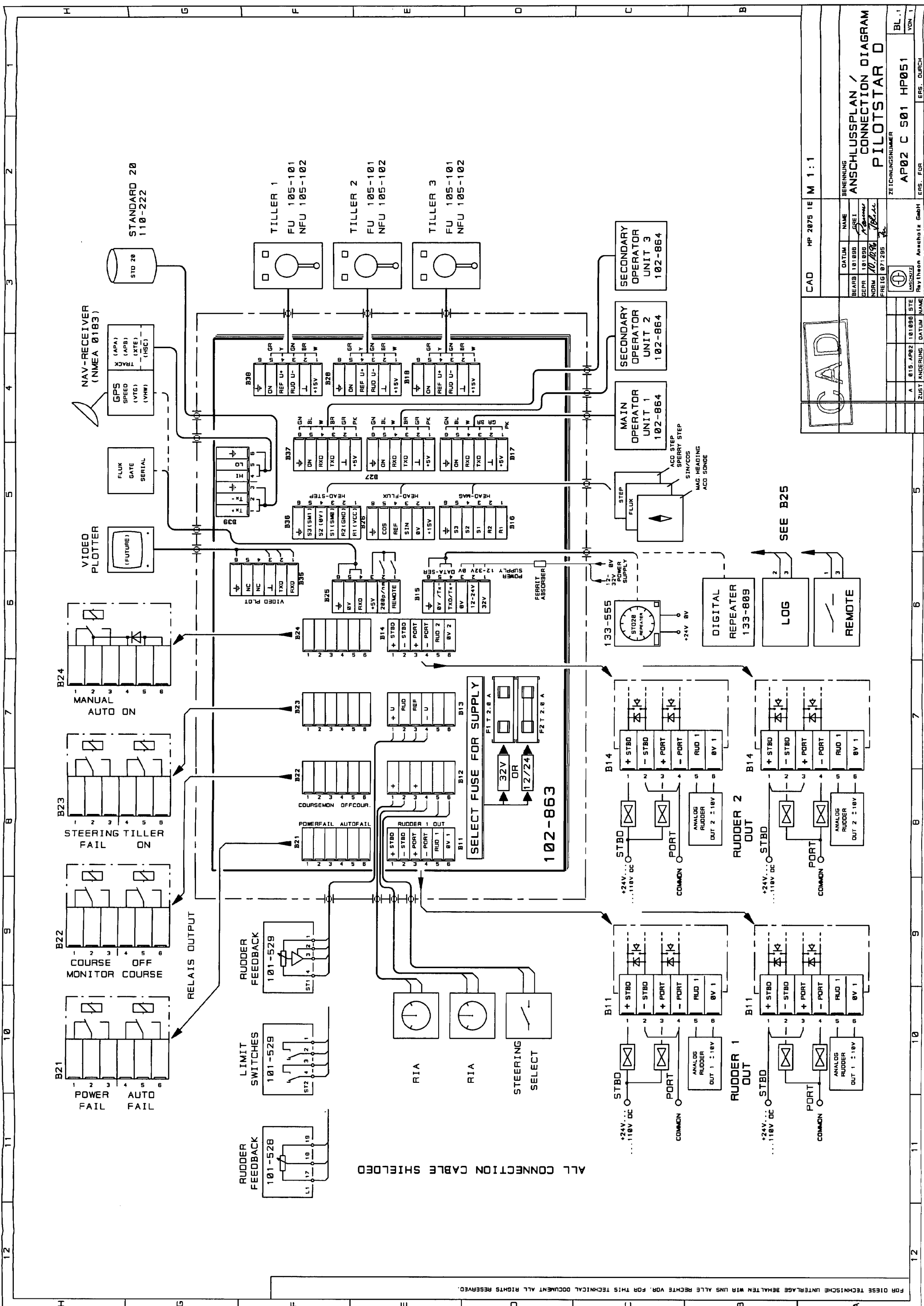
Indicates the **course difference** of between set course and actual course.
Indicates the preset **monitoring limits**

SET HEADING indication

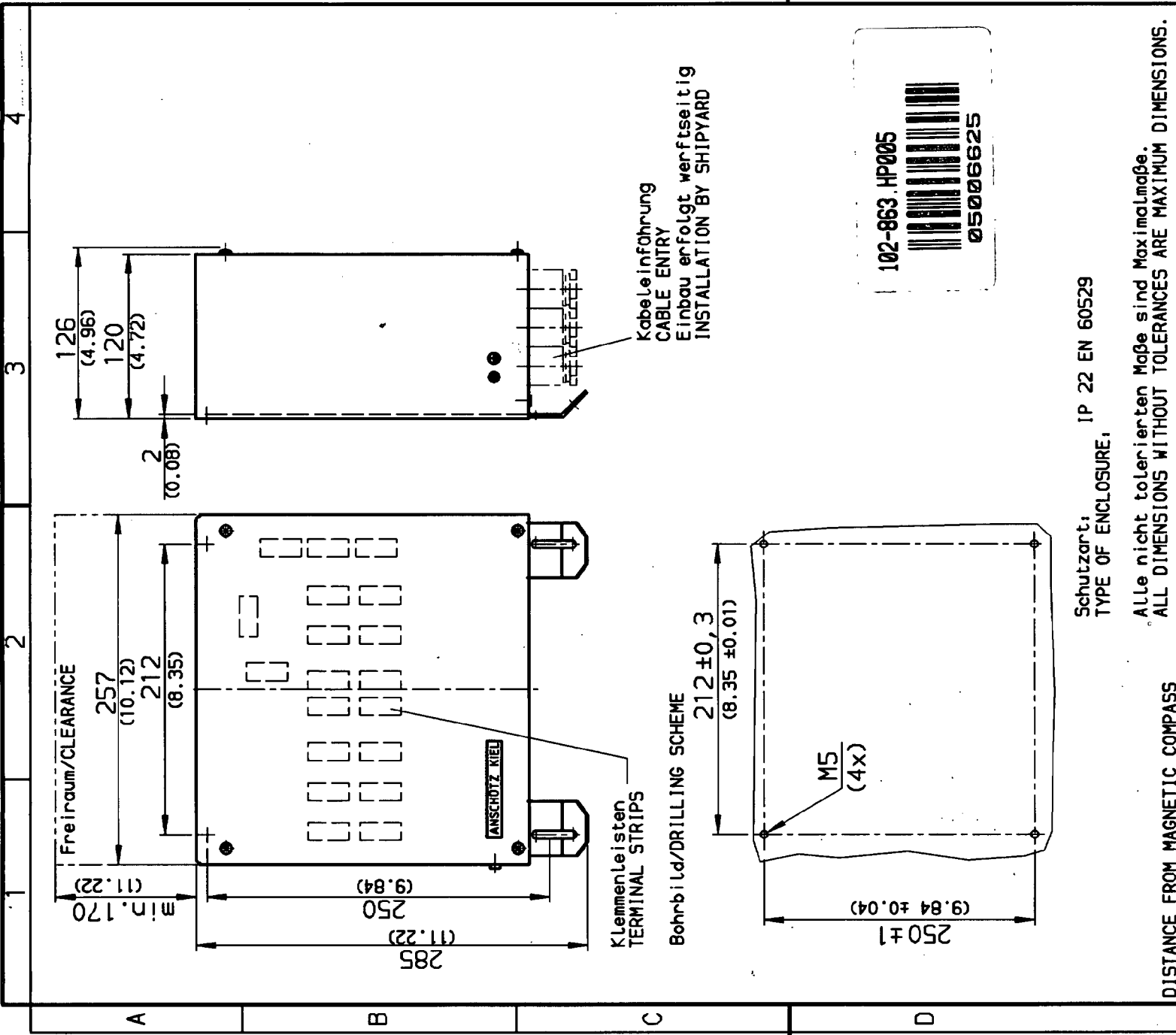
Edition: March 13, 2009

Annex – 1

3060.DOC012



MED111\$DKB100, [MEDSCHE.ZE.102] ZE_102_863_HP005, SHE/17-MAR-97/13,54,14



Schutzart: IP 22 EN 60529
TYPE OF ENCLOSURE:

Alle nicht tolerierten Maße sind Maximalmaße.
ALL DIMENSIONS WITHOUT TOLERANCES ARE MAXIMUM DIMENSIONS.

DISTANCE FROM MAGNETIC COMPASS

STANDARD TYPE: 0,90m
STEERING TYPE: 0,60m

CAD

CAD

CAD

Gewicht: $\approx$ 3 kg
WEIGHT:

Maßstab

Arbeitspause

mm
(INCH)

1997

Datum

Name

Bearb.

Gepr.

Norm

Freigabe:

03.11.94

Anschrift

Anschrift

Anschrift

Anschrift

Anschrift

Anschrift

Anschrift

Anschrift

Anschrift

Anschrift

Anschrift

Anschrift

Anschrift

Anschrift

Anschrift

Anschrift

Zust.	Änderung	Datum	Name
b	3127.102 n. Urz.	17.03.97	Zm
a	3081.102 n. Urz.	21.04.95	Zm

Zust.	Änderung	Datum	Name
b	3127.102 n. Urz.	17.03.97	Zm
a	3081.102 n. Urz.	21.04.95	Zm

Zust.	Änderung	Datum	Name
b	3127.102 n. Urz.	17.03.97	Zm
a	3081.102 n. Urz.	21.04.95	Zm

Zust.	Änderung	Datum	Name
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a	3081.102 n. Urz.	21.04.95	Zm

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a	3081.102 n. Urz.	21.04.95	Zm

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a	3081.102 n. Urz.	21.04.95	Zm

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a	3081.102 n. Urz.	21.04.95	Zm

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a	3081.102 n. Urz.	21.04.95	Zm

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a	3081.102 n. Urz.	21.04.95	Zm

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a	3081.102 n. Urz.	21.04.95	Zm

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a	3081.102 n. Urz.	21.04.95	Zm

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a	3081.102 n. Urz.	21.04.95	Zm

Zust.	Änderung	Datum	Name
b	3127.102 n. Urz.	17.03.97	Zm
a	3081.102 n. Urz.	21.04.95	Zm



Anschrift

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Anschrift

JUMPER PANELS

[illegible]

SPECIAL MEASURE:

102-863, HP100



ACHTUNG



**VORSICHTSMASSNAHMEN
BEI HANDHABUNG
ELEKTROSTATISCH
ENTLADUNGSGEFAHRDETER
BAUELEMENTE
BEACHTEN**

HIERZU POS. 10 UND 11

CAD

CAD HP 4035 1G		ALLGEMEINTOLERANZ ISO 2768 - mK	
	2001	DATUM	NAME
		BEARB.	06.07. KE/STE
		GEPR.	06.07. Lülle
		NORM	17.07.01 Holzstg
		FREIG.	18.08.94 Pz.
D 3174 . 102 050701 STE		C 3125 . 102 000197 KE	
B 3094 . 102 140895 KE		A 3082 . 102 100595 KE	
ZUSTÄNDERUNG		DATUM	NAME
Raytheon			
Raytheon Marine GmbH Germany			

AUFTRAGS-NR.

ORDER NO.:

FUR SERVICE-GR.: 102-863.100
FOR SERVICE GROUP.

BENENNUNG	CPU-KARTE	PSD
	CPU PCB	PSD

ZUSAMMENSTELLZEICHNUNG MIT KONFIGURATION/
ASSEMBLY DRAWING WITH CONFIGURATION

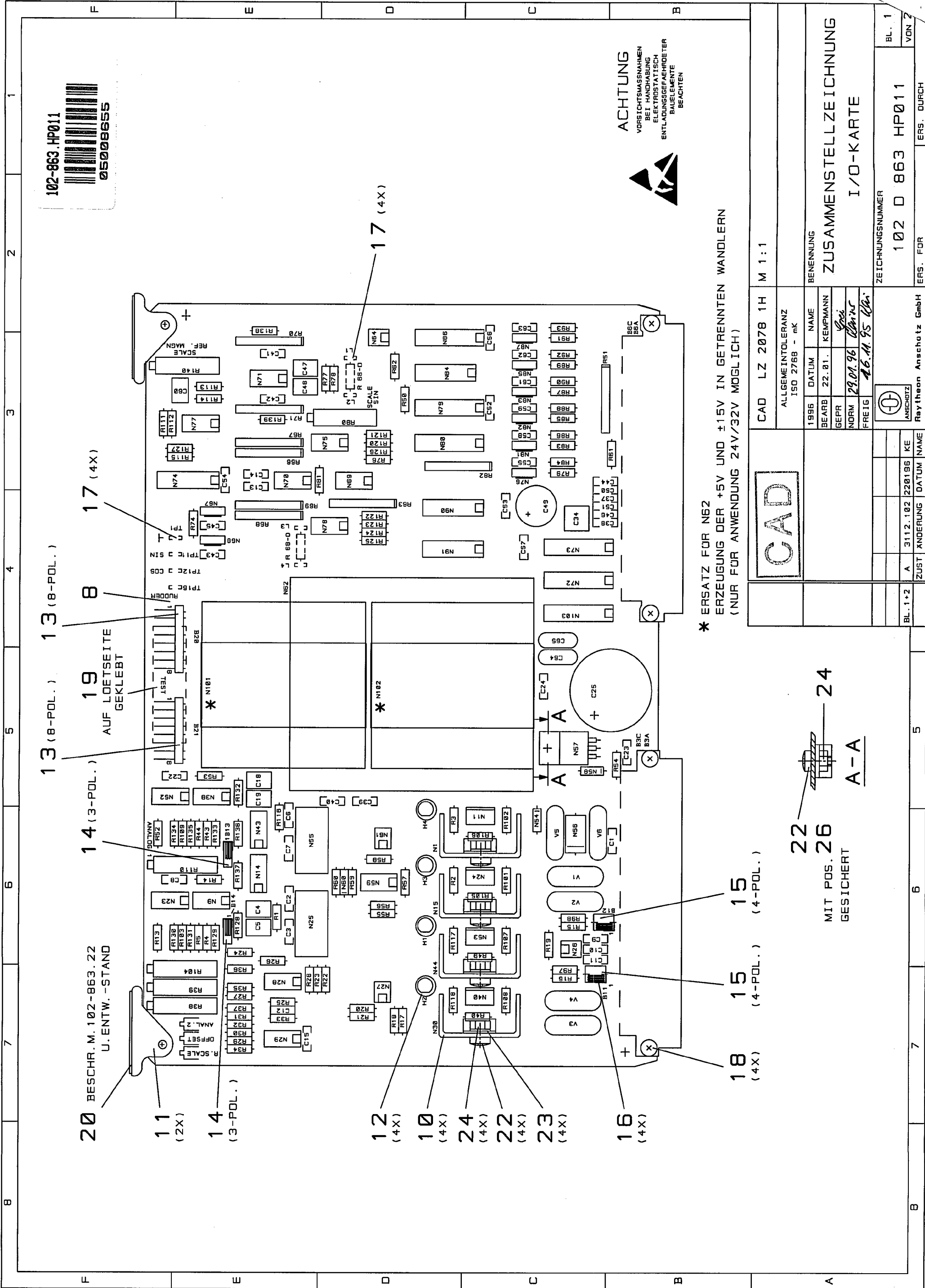
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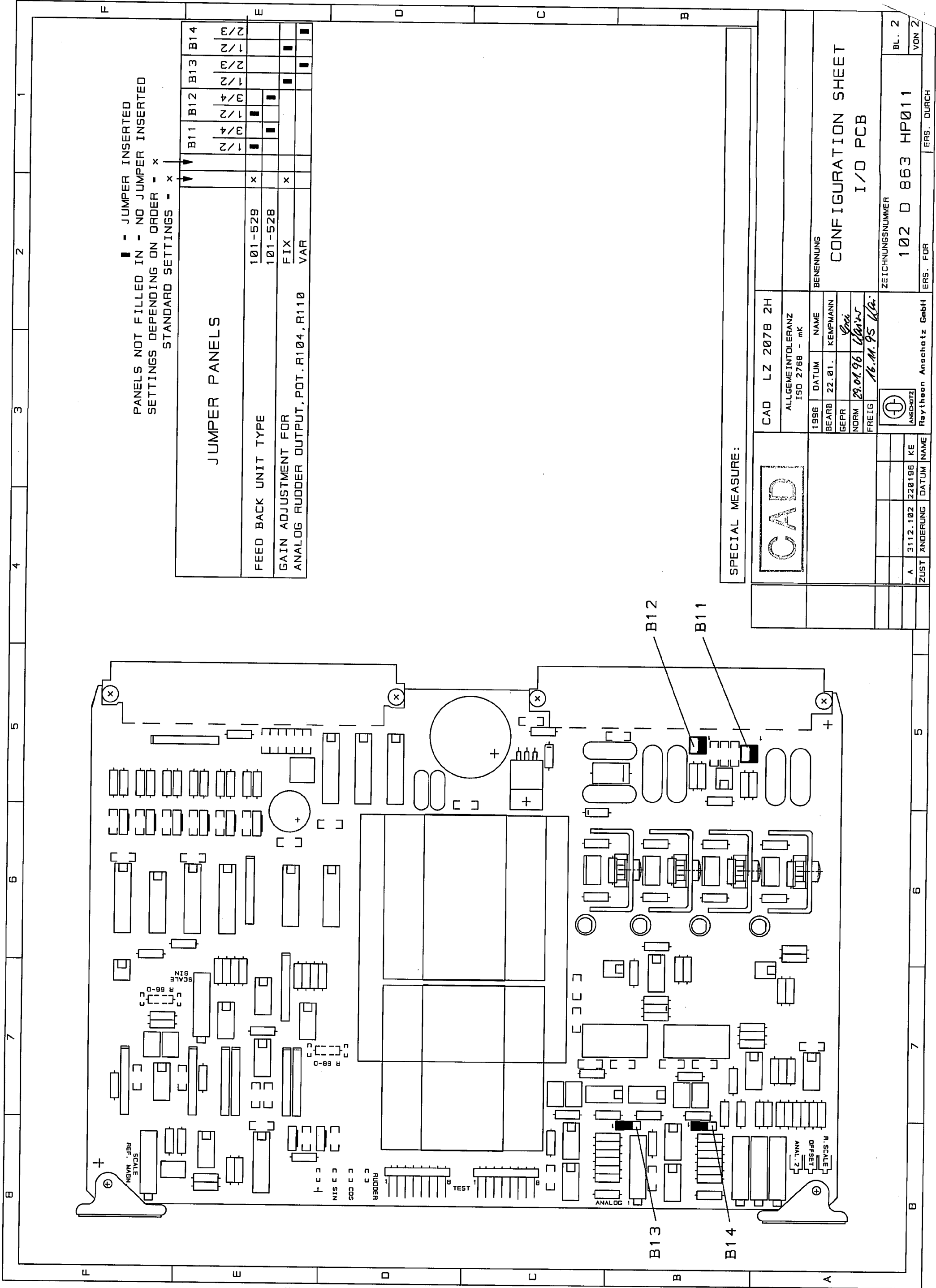
102 0 863 HP100

ERS. FÜR

RS. DURCH

5 BESCHR. M. 102-063. 100 U. ENTW. - STAND





JUMPER PANELS

FEED BACK UNIT TYPE	B11	B12	B13	B14
101-529	x			
101-528				
GAIN ADJUSTMENT FOR				
ANALOG RUDDER OUTPUT, POT. R104, R110				
FIX	x			
VAR				

SPECIAL MEASURE:

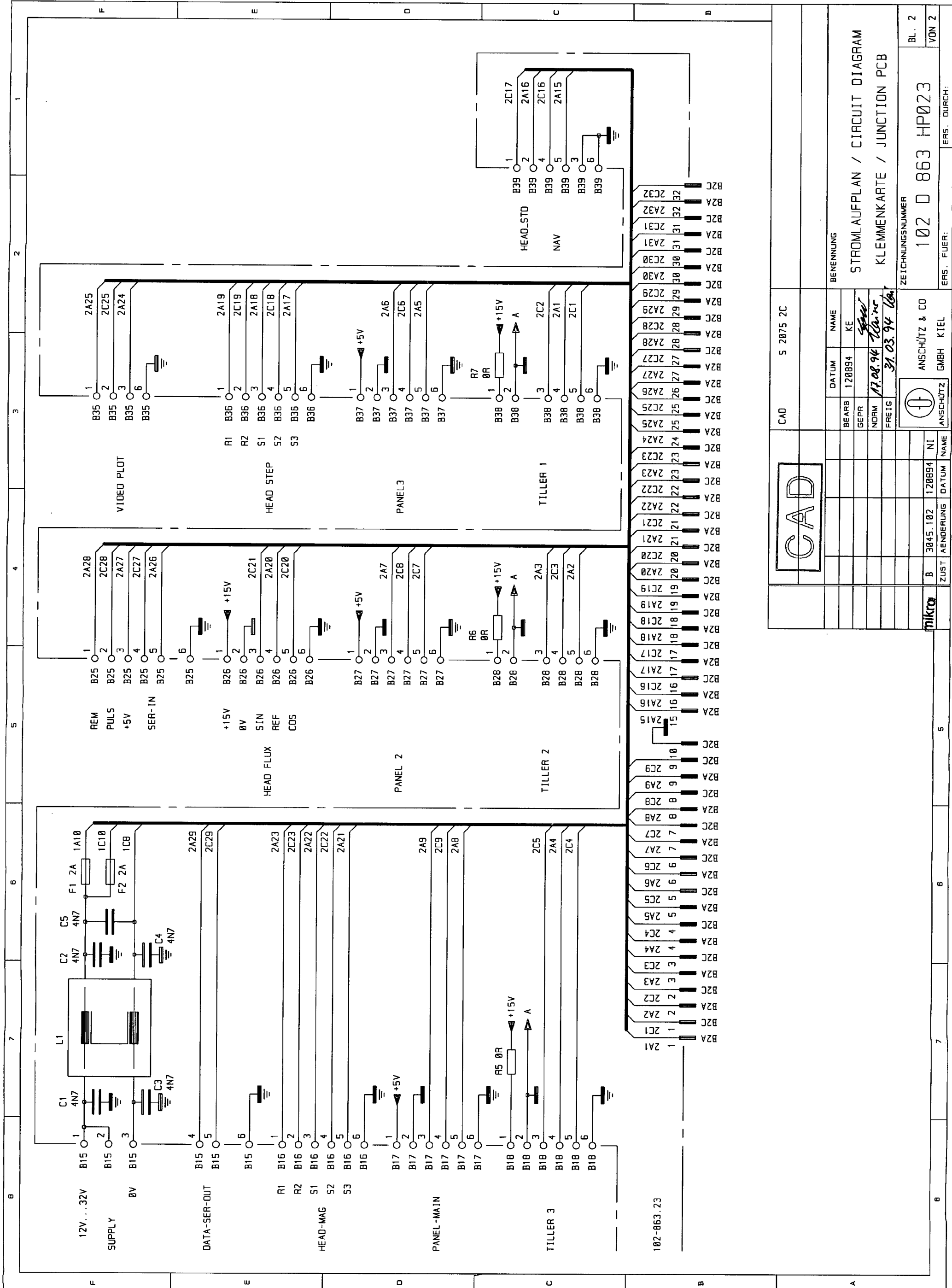


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ALLGEMEINTOLERANZ ISO 2768 - mK		
1996	DATUM	NAME
BEARB	22.01.	KEMPMANN
GEPR		
NORM	29.01.96	W. M. 95
FREIG		
ANSCROTZ Raytheon Anschutz GmbH		
A	3112.102	228196
ZUST	ANDERUNG	DATUM
ERS. FÜR		
ERS. DURCH		
BL. 2		
VON 2		

CONFIGURATION SHEET

I/O PCB

ZEICHNUNGSNUMMER	
102 D 863 HP011	
ERS. FÜR	
ERS. DURCH	
BL. 2	
VON 2	



CAD		S 2075 2C		BENENNUNG		STROMLAUFPLAN / CIRCUIT DIAGRAM		KLEMMENKARTE / JUNCTION PCB		BL. 2	
B		3045.102		ANSCHÜTZ & CO		102 D 863		HP023		VON 2	
ZUST		ÄNDERUNG		DATUM		NAME		ERS. FÜHR:		ERS. DURCH:	
mikro											

POS. 16 BEI BELEGUNG DER KLEMMEN ENTFERNEN

VORSICHTSMASSNAHMEN
BEI HANDHABUNG
ELEKTROSTATISCH
ENTLADUNGSGEFÄHRDETER
BAUELEMENTE
BEACHTEN

[illegible]

05006732

DA C

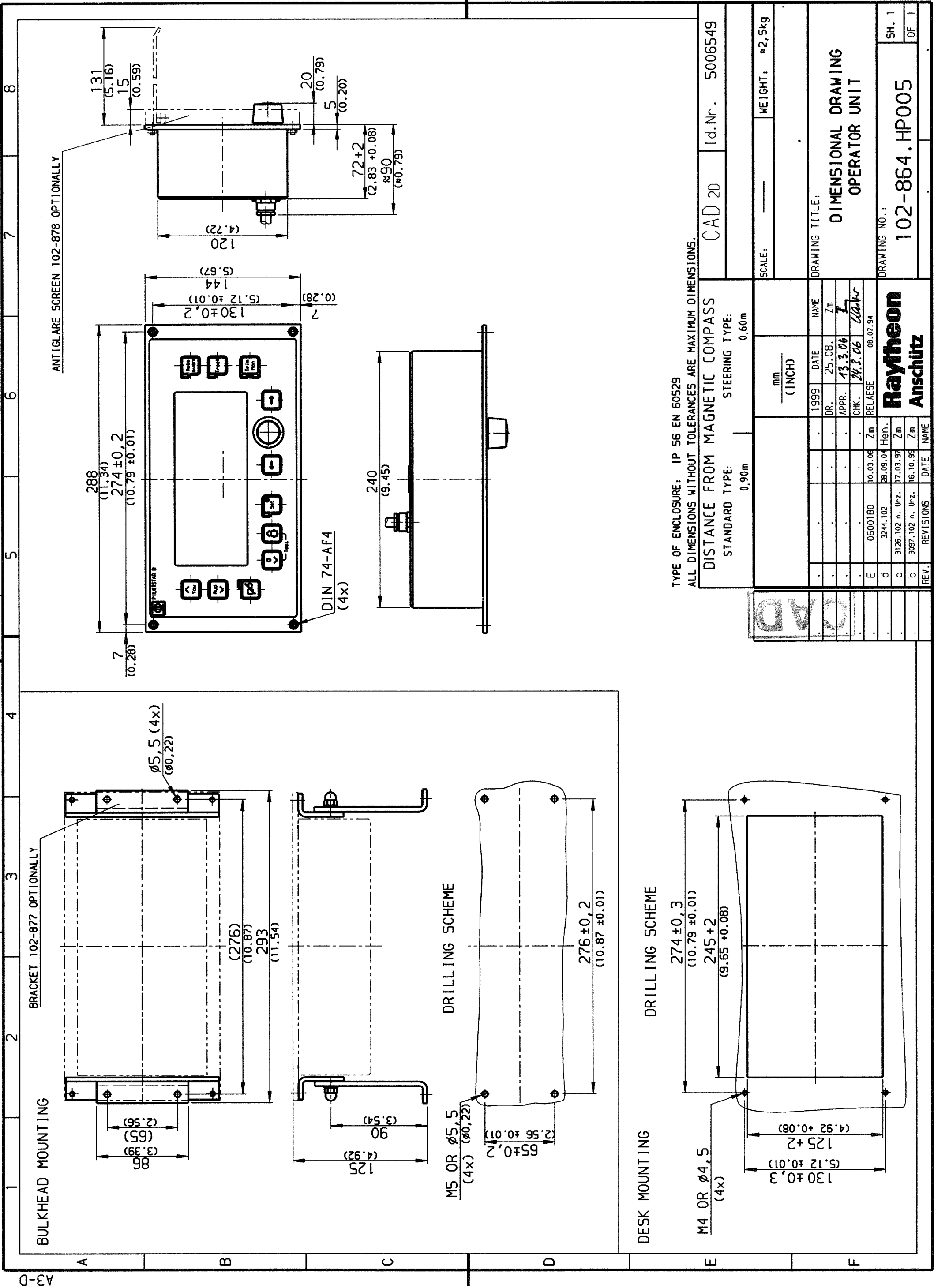
ALLGEMEINTOLERANZ
ISO 2768 - MK

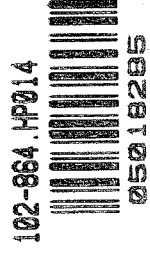
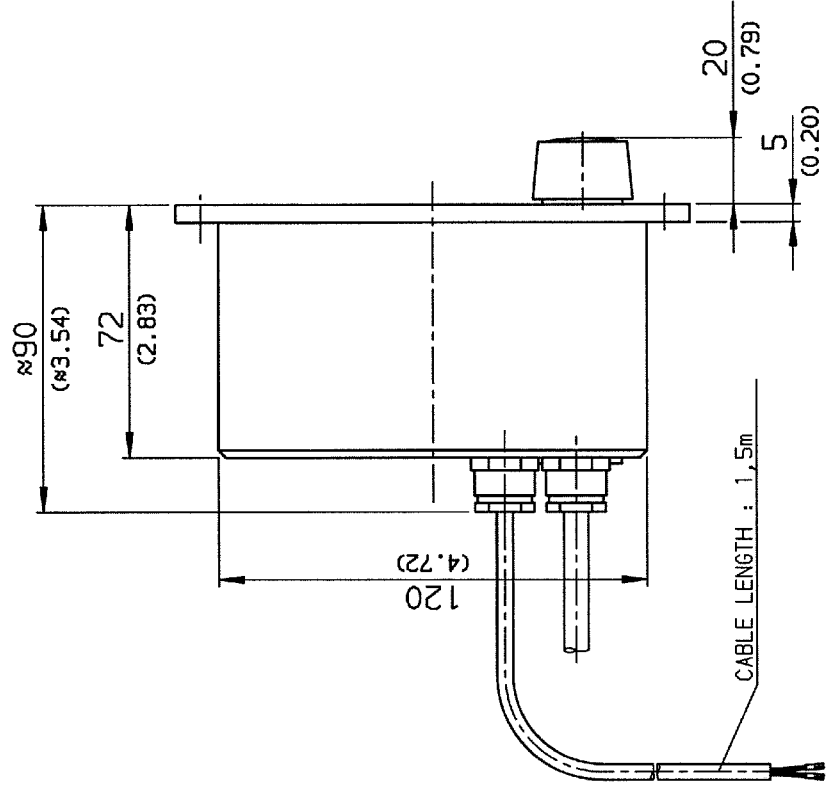
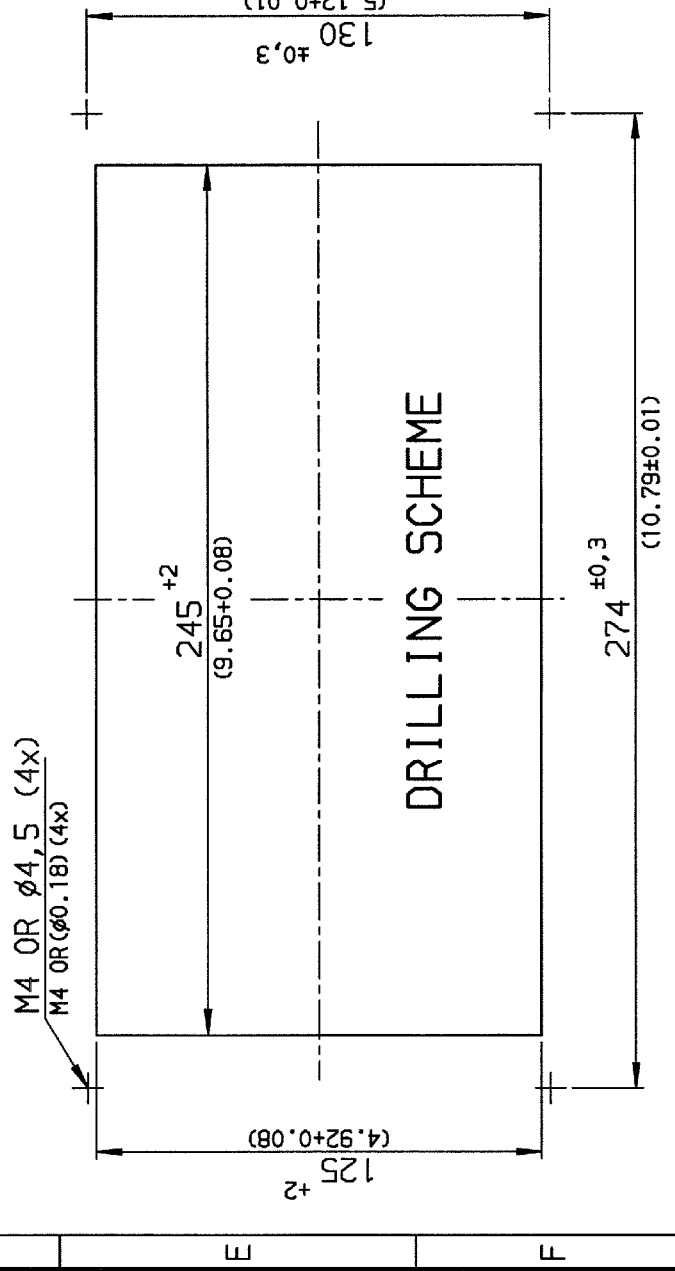
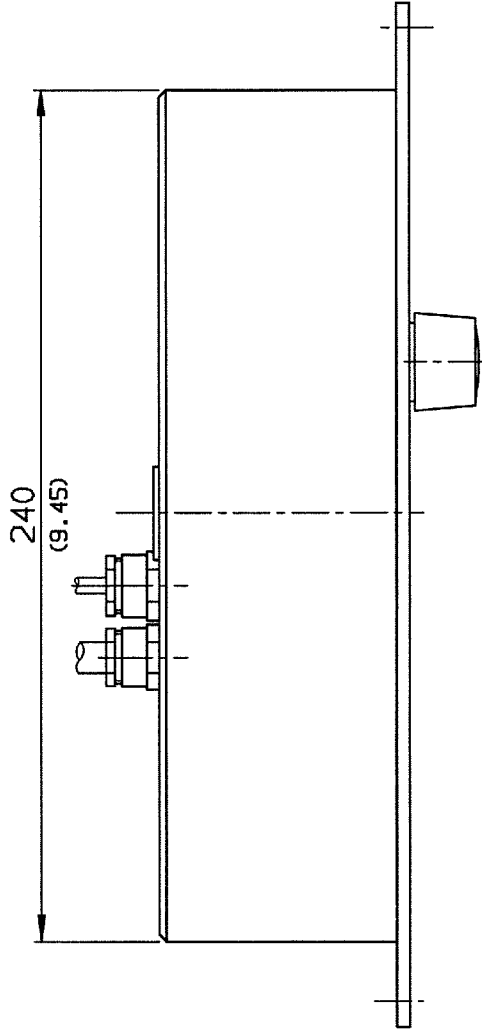
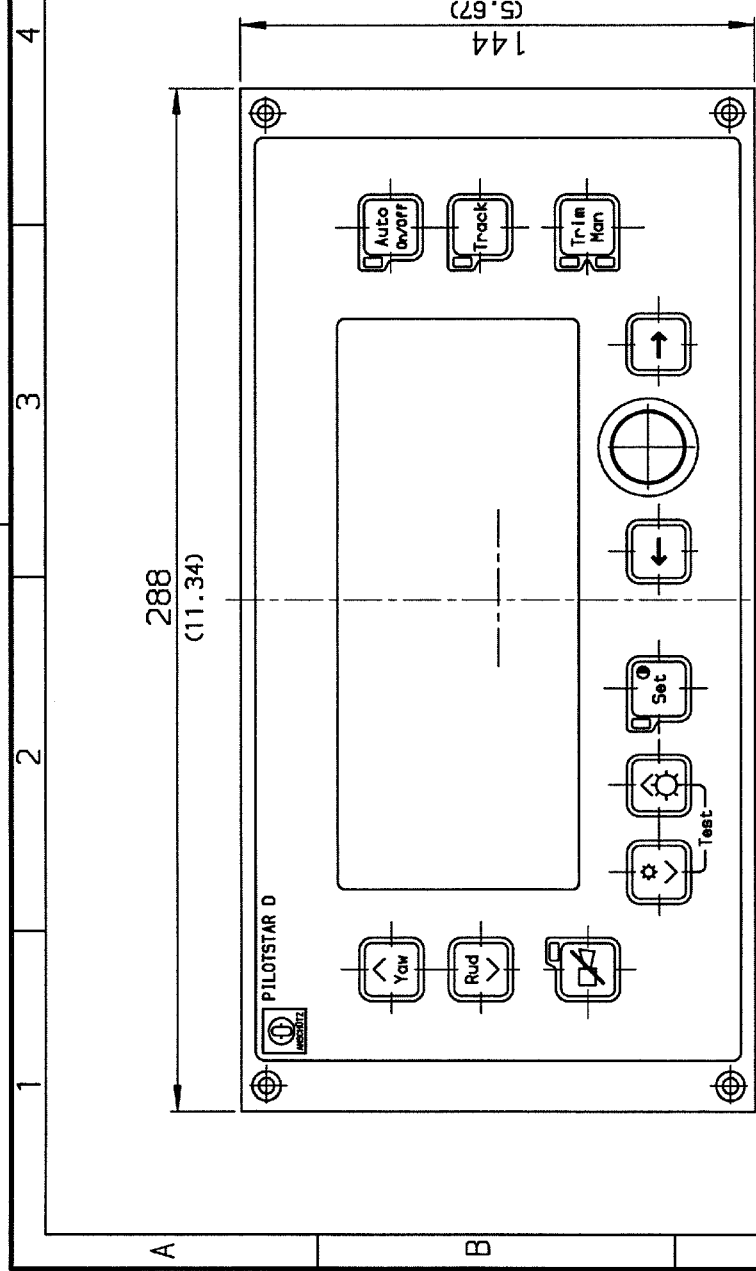
ZUSAMMENSTELLUNG
KLEMMKARTE

ZEICHNUNGSNUMMER	
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102 0 863 HP010

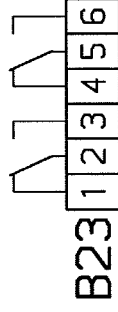
ERS. FÜR	ERS. DURCH
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ALSO CONNECT B23.5/6 FROM
ELECTRONIC CONNECTION BOX 102-863.
TO CENTRAL ALARM PANEL:

STEERING
ALARM
FAILURE
RESET



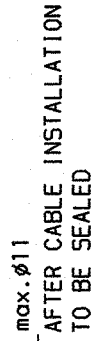
✱REFERRING TO DRILLING SCHEME ON BOARD SHIP

TYPE OF ENCLOSURE : IP 23 EN 60529

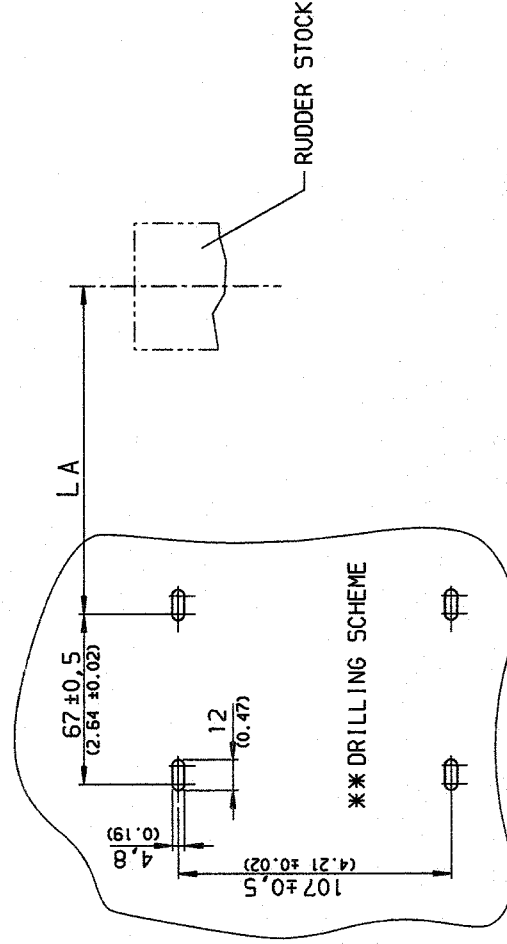
ALL DIMENSIONS WITHOUT TOLERANCES ARE MAXIMUM DIMENSIONS

DISTANCE FROM MAGNETIC COMPASS		STEERING TYPE:		SCALE	
STANDARD TYPE:		0,90m		0,60m	
mm		(INCH)		Arbeitspouse	
2004		DATE		NAME	
DR.		21.12.		Haf	
APPR.		11.2.05		1/3	
CHK.		11.2.05		1/3	
RELEASE:		11.2.05		1/3	
REV.		REVISIONS		DATE	
NAME		DATE		NAME	
Raytheon		Raytheon Marine GmbH		Germany	
DRAWING NO.:		102-864.HP014		SH. 1	
OF 1					

DRIVING ELEMENTS DEPENDENT ON THE SYSTEM



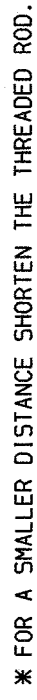
-AFTER LOOSENING THE SCREW, THE BELT PULLEY CAN BE TURNED WITH REGARD TO THE POTENTIOMETER.



— RUDDER STOCK

DISTANCE FROM MAGNETIC COMPASS STANDARD TYPE: 0.45m		STEERING TYPE: 0.30m		CAD			
mm (INCH)				SCALE 1:2		WEIGHT: 81kg	
1995		DATE		NAME		DRAWING TITLE:	
DR.		02.02.		Zm		FEEDBACK UNIT	
APPR.		22.6.05		Mgk		DIMENSIONAL DRAWING	
CHK.		13.6.05		Sya		DRAWING NO.:	
RELEASE:		02.03.94				SH. 1	
D		1181.101		Zm		101-529.HP005	
c		1146.101		Zm		OF 1	
b		1120.101 n. W-2.		Zm			
a		1105.101 n. W-2.		Zm			
REV.		REVISIONS		DATE			

OPERATING ANGLE 0 - $\pm 45^\circ$



OPERATING ANGLE $\pm 45^\circ$ - $\pm 90^\circ$
(LA = 172)

RUDDER STOCK

M4 (4x)

35 ± 0.2 (1.38 ± 0.01)

0.5

131.5 (5.18)

12.5 ± 0.8 (0.49 ± 0.03)

10 (ø0.38)

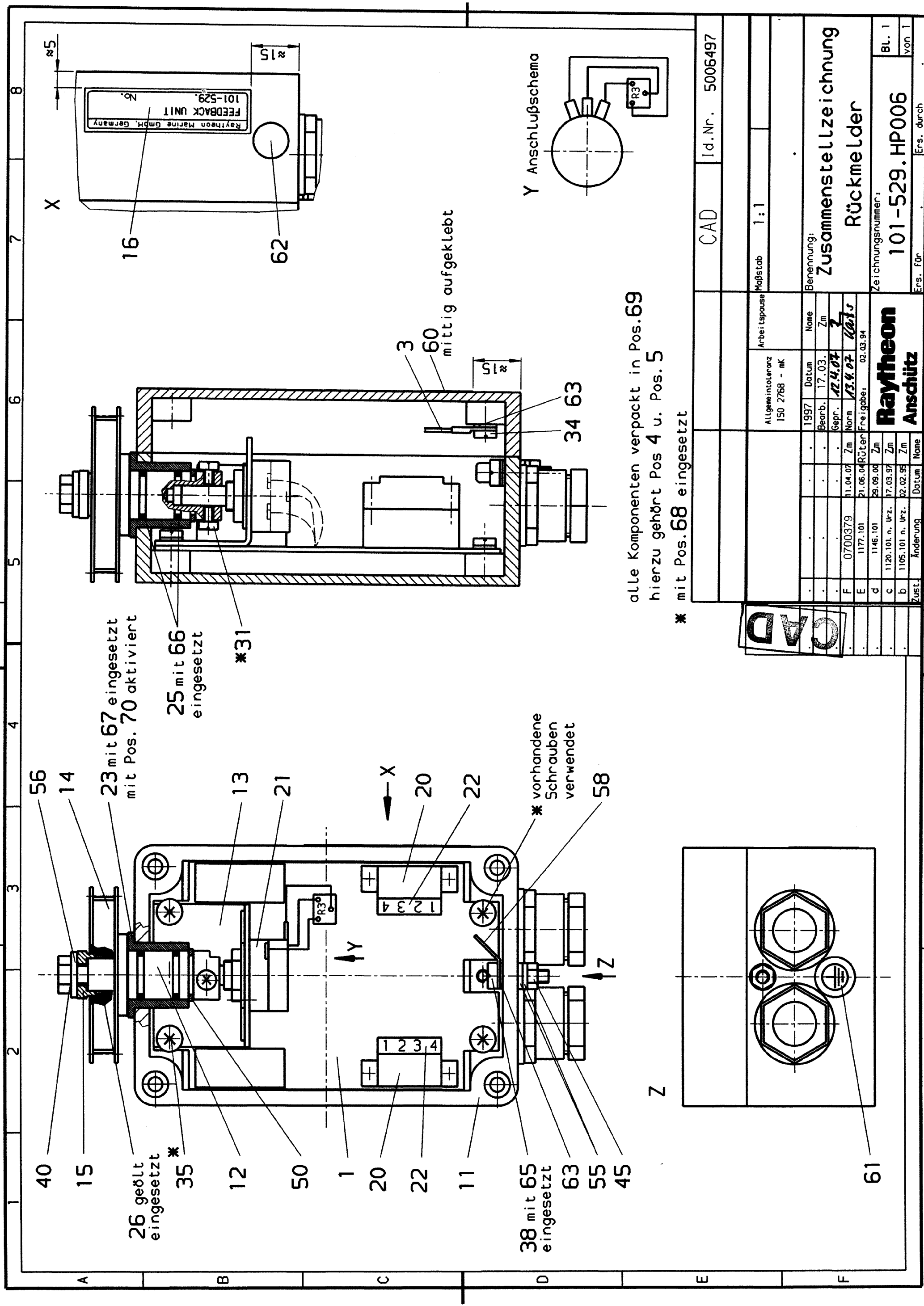
9 (0.35)

12 (0.47)

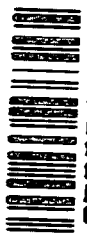
(LA = 172)

101-528 HP005

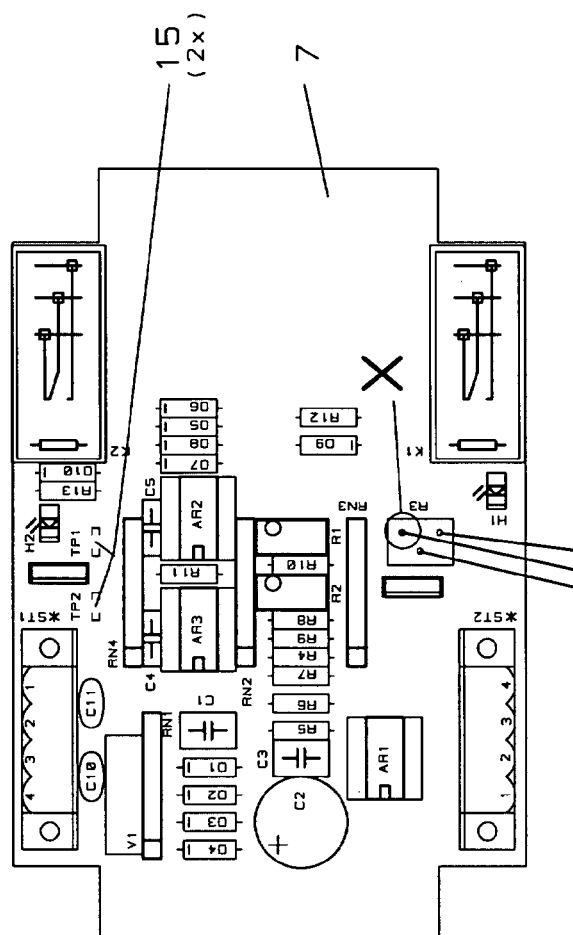
05086496



101-529.HP010



FÜR DIESE TECHNISCHE UNTERLAGE BEHALTEN WIR UNS ALLE RECHTE VOR. FÜR THIS TECHNICAL DOCUMENT ALL RIGHTS RESERVED.



X

ACHTUNG



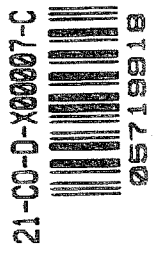
**VORSICHTSMASSNAHMEN
BEI HANDHABUNG
ELEKTROSTATISCH
ENTLADUNGSGEFAHRDETER
BAUELEMENTE
BEACHTEN**

5MM VERDRILLT
UND VERZINT

BARCODE-SCHILD
AUF LÖTSEITE

* ST1 + ST2 MIT POS.10 GEKLEBT

CAD		CAD		LZ 5086 E		M 1 : 1			
				ALLGEMEINTOLERANZ ISO 2768 - mK					
				BENENNUNG		RÜCKMELDER-PCB ZUSAMMENSTELLZEICHNUNG			
		2003		DATUM		NAME			
		BEARB		13. 02.		ARENDT			
		GEPR		13. 02.		W. v. v.			
		NORM		17. 1.		Ska			
		FREIG		15. 02. 94					
		D		1167. 101		130203		ADT	
		C		1129. 101		230498		RM	
		B		1106. 101		130295		STE	
		A		1096. 101		200294		STE	
		ZUST		ÄNDERUNG		DATUM		NAME	



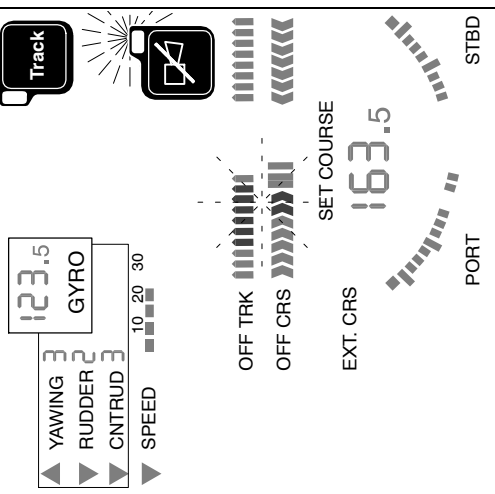
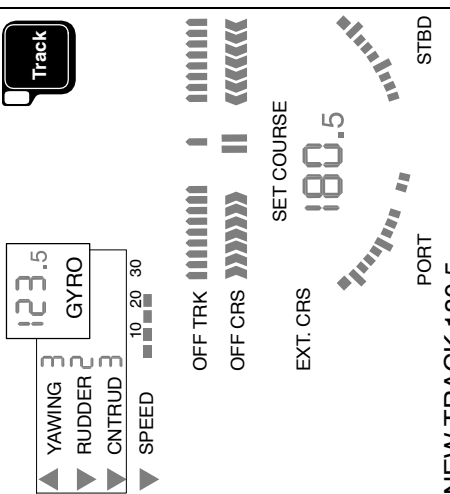
PILOTSTAR D

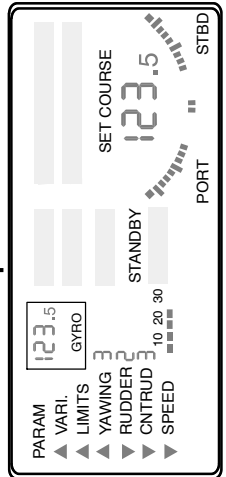
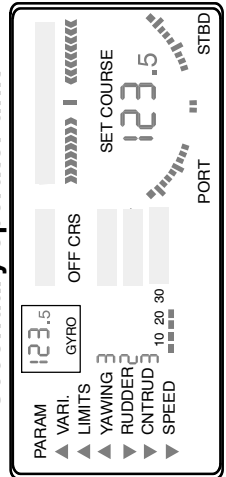
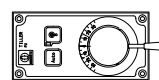
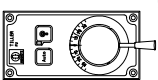
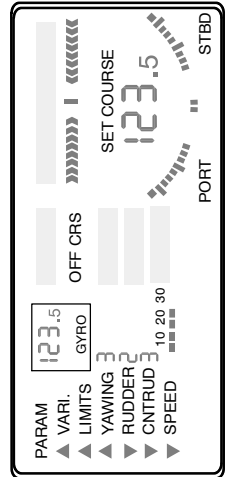
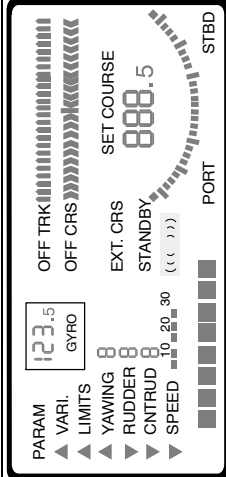
Operating Instructions, Short Version



	Indications	Remarks, Notes
④	Heading Control with TRIM FUNCTION	
	 YAWING 3 RUDDER 2 CNTRUD 3 SPEED 10 20 30 123.5 GYRO OFF CRS >>>>>> <<<<<<<< SET COURSE ♦ 123.5 STBD	- This operating mode will be active on actuating the key twice. The resulting situation is as follows: The 2nd set of parameters appears and is effective. The rudder limitation is eliminated. The HEADING is accepted as SET HEADING presetting. Heading change manoeuvres are now to be performed exclusively via the rotary knob. Within the text line, the manual trim rudder value in "on" can be read off (see Point ⑤).
⑤	TRIMMING the rudder presetting	
 	 YAWING 3 RUDDER 2 CNTRUD 3 SPEED 10 20 30 123.5 GYRO OFF CRS >>>>>> <<<<<<<< SET COURSE ♦ 123.5 STBD	- By actuating an arrow key, the intended TRIM rudder value can be adjusted. The sign describes the rudder position, "–" for PORT, "no sign" for STBD. - If both keys are actuated simultaneously, the TRIM value will automatically be reset to 0°. The resulting situation is as follows: Indication and situation as under Point ④. The rudder position changed by 1° steps. The automatic rudder bias is now switched off. The TRIM rudder value is not stored, after changing the operating mode, it will be set to 0°. The automatic rudder bias will now be connected again. Changing the operating mode may bring about an unintended reaction of the ship. For this reason, the TRIM rudder value should be reset to 0° step by step before the operating mode is changed. 
⑥	Operating Mode MANUAL CONTROL (DODGE Function)	
	123.5 GYRO SET COURSE ♦ 123.5 MAN RUDDER PORT STBD	- By actuating the key for the first time, this operating mode is adjusted. The resulting situation is as follows: The operating modes of HEADINGCONTROL or TRACK CONTROL are no longer active.  The operational parameter settings are now in effective (no rudder limitation, no RATE OF TURN presetting). A rudder position of 0° is adjusted as rudder value. The SET HEADING is caused to follow up the HEADING.
⑦	Heading Change Manoeuvre via MANUAL CONTROL	
  	123.5 GYRO SET COURSE ♦ 123.5 MAN RUDDER -10 PORT STBD	- The rudder presetting can be adjusted via the rotary knob or via the PORT/STBD keys (resolution 1°). - If both keys are actuated simultaneously, the rudder is automatically brought to midships position. The resulting situation is as follows: Indication and situation as under Point ⑥.  The rudder order acts directly upon the steering gear. The current rudder angle is numerically indicated via the next line. The sign indicates the rudder position, "–" for PORT and "no sign" for STBD.



	Indications	Remarks, Notes
		
	Operating Mode TRACK CONTROL (in Conjunction with a Navigation Receiver only)	
  	 xte meter 140 (for approx. 3s) NEW TRACK 163.5	- The following pre-conditions have to be fulfilled: • Track control on the navigation receiver • The ship has been turned into the AHEAD direction with regard to the track (angular range approx. α 60°)! • The ship has been within the track monitoring limits. - By actuating the key, the operating mode is preselected. The resulting situation is as follows: Audible signalling is heard, the LED of the symbol key is flashing. Within the text line, the track heading data offered by the navigation of the receiver is indicated. Actuation of the symbol key results in that the audible signalling is silenced. The text line becomes dark, the track heading data is accepted as set heading presetting and appears in the SET HEADING indication. The OFF TRACK and OFF HEADING monitoring will be active only when the SET HEADING presetting is reached. If the ship is still outside the pre-defined monitoring limits, sub-segments of the bar graph indication will be flashing. This track run-in phase is terminated as soon as the planned track has been reached. The rudder position indicator shows the set rudder angle by 2° steps.
	Track Change	
 	 NEW TRACK 180.5	- A pending track change manoeuvre is recognized via the external navigation system. The resulting situation is as follows: Within the text line, the new track heading appears. The LED of the symbol key is flashing, audible signalling is heard. On actuating the symbol key, the track heading value changes into the SET HEADING indication. The text line becomes dark, the audible signalling is silenced. The track change manoeuvre is carried out via the PILOTSTAR D. i If the track change manoeuvre cannot be initiated within an adequate time, an exact track control is not longer possible. The ship will continue on the still valid track course of the former track section, thus leaving the planned route. The audible and visual signalling remain in existence until a decision is made (acknowledgement of new track heading or change-over to another operating mode).

	Indications	Remarks, Notes
		
	Change-over between Main and Secondary Operator Units	
	Main operator unit  Secondary operator unit 	- Change-over is performed by actuating the key on the intended operator unit. The resulting situation is as follows: The main operator unit is given the STANDBY status (see Point ). The secondary operator unit is declared to be the steering station. Change-over is announced via an audible signal repeated three times. i For changes in configuration, switching back to the main operator unit is required.
	Change-over to Tiller Control (FU / NFU)	
 		- Change-over is performed by actuating the key on the tiller. The resulting situation is as follows: All operator units are given the STANDBY states (see Point ). The tiller is declared to be the steering station.
	Switching back to PILOTSTAR D	
  	 	- Change-over is performed by actuating the key on the tiller. - or by actuating the key on the PILOTSTAR D operator unit. The resulting situation is as follows: The main operator unit is switched to operating mode HEADING CONTROL. The last HEADING is accepted as SET HEADING.
	Lamp test	
 		- The lamp test is released by actuating the keys simultaneously (for a time of approx. 5s). The resulting situation is as follows: During the test phase - all keys has been alight with equal intensity - all LEDs has been alight - within the LCD display, all sequents has been activated - audible signalling has been heard Subsequent to the test, the previous operating mode with the corresponding indications adjusts itself again.